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ADVANCED FLIGHT SIMULATOR: UTILIZATION IN A-10 CONVERSION AND AIR-TO-SURFACE ATTACK TRAINING

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NOTICE

This final report was submitted by the Operations Training Division, Air Force Human Resources Laboratory, Williams Air Force Base, Arizona 85224, under Project 1123 with HQ Air Force Human Resources Laboratory, Brooks Air Force Base, Texas 78235. Dr. Thomas H. Gray was the Principal Investigator for the Laboratory.

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The purposes of this research were to develop transition and surface attack simulator training programs for novice A-10 pilots and to determine simulator features and capabilities required for effective training in the air-to-surface (A/S) mission. These goals were refined to four specific objectives: development of a transition and surface attack syllabus; generation of objective performance measurement algorithms; determination of design requirements for instructor stations; and assessment of the utility of advanced instructional features.

These objectives were accomplished using A-10 Instructor Pilots and four classes of "B" course students who had recently completed Undergraduate Pilot Training and Fighter Lead-In School. Each class received two

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blocks of instruction on the Advanced Simulator for Pilot Training (ASPT). The first block consisted of 4 to 8 hours of conversion training with primary emphasis on traffic pattern work. The second block of training was composed of 4 to 7 hours of A/S weapons delivery (i.e., dive bombing and strafe).

The key findings ~~of the study~~ were:

(1) For the initial phases of weapons delivery training, the transfer of training from the ASPT to the A-10 is nearly 100 percent, therefore, in the early phases of A/S training, one simulator mission can effectively replace one aircraft mission, thus allowing actual flying time to be transferred to other phases of training;

(2) Objective assessments of piloting and weapons delivery skills are highly useful in A-10 training;

(3) Improvements are needed in the display and controls at the A-10 instructor station.

4. Many advanced instructional features are not fully utilized by the IPs, implying either that they may not be required for achieving effective weapons delivery training or that the IPs need more training on the use of these features to enhance student learning.

PREFACE

This research was performed by the Operations Training Division of the Air Force Human Resources Laboratory, Williams AFB, Arizona, and supported by the 355th Tactical Fighter Wing of the Tactical Air Command, Davis-Monthan AFB, Arizona. The effort was completed under Project 1123, Flying Training Development; Task 112311, Operational Command Training Program Support; and Work Unit 11231104, Surface Attack Training Study I. Mr. J. F. Smith was the Project Monitor and Dr. T. H. Gray was the Principal Investigator.

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ADVANCED FLIGHT SIMULATOR: UTILIZATION IN A-10 CONVERSION AND AIR-TO-SURFACE ATTACK TRAINING

I. INTRODUCTION

This technical report is comprised of four distinct efforts, each written as a section complete in itself. The report is the result of the efforts of many individuals with diverse backgrounds and interests, each specializing to some extent in work on one aspect of an urgent Air Force problem. The advantages of this multidisciplinary approach for quickly reaching a solution are obvious; the disadvantage lies in the difficulty of producing a succinct and coherent report that unites these four efforts. However, all four activities were performed under one work unit in response to one Request for Personnel Research (RPR), and for this reason, they are combined in a single document.

Background

The first investigation by the Air Force Human Resources Laboratory (AFHRL) into the air-to-surface (A/S) weapons delivery task is discussed by Hutton, Burke, Englehard, Wilson, Romaglia, and Schneider, 1976. The results of this project indicated that a large field-of-view simulator could provide excellent training in A/S attack operations. Building on this base, a study was conducted to determine the effects of generalized A/S simulator weapons delivery training upon newly rated pilots (Gray & Fuller, 1977). It was found that such training produced high positive transfer to an actual aircraft (the F-5B) even though the fidelity of simulation was not particularly high.

Concurrent with these developments, the A-10 aircraft was being introduced into Air Force service. This event presented the Tactical Air Command (TAC) with a unique set of training problems. The A-10 is a single-place aircraft designed solely for the A/S attack mission. This fact greatly increases the difficulty of the piloting task for the newly rated aviator. The first flight must be a successful solo, and the follow-on A/S training in the aircraft is composed of highly hazardous activities. From the TAC viewpoint, the training technology in support of the weapons system was deficient on two major counts. First, A-10 flight simulators were not in the inventory and would not be available for several years. Second, there was no quantitative information that could be used to design conversion and tactical A/S training programs that could employ such simulators when they came on the line.

To obtain information which could be applied to the courseware aspects of the training problem, TAC wrote an RPR concerned with the operational employment of wide-angle visual simulation. AFHRL saw this request as a natural extensiuon of its A/S research activities and responded with a favorable evaluation of the RPR. Simultaneously, TAC requested AFHRL support in training students newly graduated from Undergraduate Pilot Training (UPT) to fly the A-10. The coincidence of these two requests presented a rare opportunity. If the Advanced Simulator for Pilot Training (ASPT) could be suitably modified, an alternative to initially dangerous and expensive aircraft training would exist which also offered considerable research potential. The resulting program that was jointly agreed upon by TAC and AFHRL had numerous advantages for both organizations. TAC would meet critical training requirements in a safe and timely manner. In addition, TAC would benefit from the research performed on simulator design features and the development of the training programs associated with the effort. AFHRL could begin a major research thrust in the tactical training arena. Substantial contributions would be made to other Simulator Special Projects Office technical needs. The ASPT hardware and software would be updated. Finally, A-10 student pilots and instructors would be available for use as experimental subjects.

Through the joint efforts of AFHRL and TAC, the ASPT was changed to an A-10 configuration (Cyrus & Fogarty, 1978). The successful completion of this step permi objectives to be achieved. First, AFHRL had the capacity to conduct valuable research on A/S fighter aircraft simulator training. Second, TAC had a system with the potential to provide the novice pilot training in A-10 conversion and surface attack tasks.

This mutually beneficial aspect of the program was followed throughout. The dual utilization of apparatus and subjects (i.e., training for TAC and research for AFHRL) was quite successful and enabled both organizations to advance their mission objectives. A two-phase program was planned. In the first phase, the ASPT would be configured to provide minimal (but adequate) cues for conversion and introductory A/S training. This approach would meet operational deadlines and yet allow valid research on several of the items requested in the TAC RPR. In the second phase, the ASPT would reach full-mission capability and a much wider range of research issues would be addressed.

Problem Statement

The overall thrust of the TAC RPR was aimed toward determining the most effective and efficient use of a wide-angle simulator visual system in a tactical A/S training program. Specific requests within the RPR were as follows.

1. Analyze conversion and tactical A/S tasks to determine how each task can be subdivided into its individual learning activities and determine the specific sequence for presenting these activities.

2. Determine the minimum essential student environment that is required to allow training in a simulator that is equipped with a wide-angle visual system.

3. Determine the optimum simulator instructional design including instructor pilot positioning that is required to monitor, control and evaluate student performance in a simulator that is equipped with a wide-angle visual system.

4. Develop a syllabus for conversion and tactical air-to-surface simulation instruction.

Objectives

To provide information on the items requested by TAC, one work unit with several "mini-projects" was planned. The broad purpose of the research was to develop conversion and surface attack simulator training programs for novice A-10 pilots and to determine simulator features and capabilities required for effective training in the A/S mission. For the initial work unit, these goals were refined into four specific objectives: development of a conversion and surface attack syllabus; generation of objective performance measurement algorithms; determination of design requirements for instructor/operator stations; and assessment of the utility of advanced instructional features. Although two objectives (syllabus development and performance measurement) were closely related in terms of an end product, the remaining two (station requirements and instructional features utility) were not. Thus, the methodology and procedures used were unique to each objective and were treated as semi-autonomous efforts.

Rationale

As is apparent, the theme pursued in this work unit was to develop an "optimum mix" program that would satisfy operational training needs *and* address research issues. At the outset, it was realized that only a small number of subjects, i.e., students and instructor pilots (IPs) would be available. But the paucity of subjects was outweighed by another factor: the absolute validity of the sample. There was no question that these individuals were representative of the population to which generalizations would be made. The TAC students and IPs who participated were those of an operational combat crew training squadron. The tasks to be trained and investigated were real-world behaviors that would have to be transferred from ASPT to the A-10. Finally, the objectivity of the criteria (parameters of aircraft control, bomb-drop circular error, and percentage of rounds through a target) left little doubt that the assessment of the results of the project would be based on measures highly relevant to real-world operations.

The method used to accomplish the project's objectives generally followed previous AFHRL training research and development activities (Woodruff, Smith, Fuller, & Weyer, 1976). Based on Instructional System Development principles (as exemplified in the T-37 Instrument Flight Simulator syllabus; Weyer & Fuller, 1977), a "cut and try" approach was used that underwent repeated evaluation and modification to discover and solve problem areas. Not only was this pragmatic approach quite successful in meeting the immediate training needs but it also yielded a product that would satisfy a future requirement: a prototype syllabus for the A-10 Operational Flight Trainer (OFT). In conjunction with the performance measurement algorithms, the syllabus provides a guideline instructional package that can be directly transferred to the Operational Flight Trainer when it comes on line.

Overshadowing all other program elements was one dominant consideration. The simulation and training had to deliver positive transfer to the A-10 aircraft. It was realized that the failure to do so would very likely have disastrous consequences. For this reason, the simulation was subjected to extensive pre-testing in order to insure high fidelity in critical flight regimes. TAC's certification of the system as fully "ready-for-training" and the subsequent results of its utilization were convincing evidence of success.

Organization of the Report

There were four research objectives to be satisfied by the work unit. For clarity, each objective is reported in a separate section. The first section deals with syllabus development; the second, section with performance measurement; the third section with instructor/operator station design; and the fourth section with advanced instructional features. The conclusions and implications associated with the topic are at the end of each section.

II. SYLLABUS DEVELOPMENT

The objective concerned with the development of a conversion and surface attack simulator training syllabus illustrates how effectively one research effort could yield two different, but highly useful, products. The first of these products was, obviously, the syllabus TAC needed for instruction. The second was an expansion of the A/S simulator training research data base.

This section is titled "Syllabus Development" but most of its content deals with the results of simulator utilization in the context of A/S training. The reason for this is that there is little to be gained by giving a labored description of the trial-and-error process by which the syllabus was produced. It is sufficient to say that the subject matter of the syllabus and the general approach to instruction relied upon AFHRL and TAC experiences in training pilots for other aircraft systems. The actual production of the syllabus proceeded on a simple step-by-step basis. After a prototype syllabus was written, it was "tested" in ASPT by IPs, modified, used for a class of students, and then redone. This process was then repeated for the next class. The syllabus that finally emerged was the result of three iterations of such refinement (Appendix A).

Background

Although it was not possible to conduct a rigorous "experiment" because of small class sizes and operational training constraints, many of the elements that comprise a typical experimental study were present. Thus, this standard reporting format is the one that will be followed in presenting the results.

Subjects. The subjects were students in the A-10 Combat Crew Training Squadron (CCTS) B-course at Davis-Monthan AFB, Arizona. All students in four CCTS B-course classes were used as subjects. The number of subjects in each class was quite small; six in the first; six in the second; five in the third; and seven in the fourth. The fourth class was used as a control group for A/S evaluations.

Instructor Pilots. The IPs for the study were drawn from the 355th Tactical Fighter Wing at Davis-Monthan AFB. All IPs were highly experienced in air-to-surface weapons delivery and were thoroughly briefed on the purposes of the study and their jobs within it. Special training on the ASPT console operation and advanced training features capabilities was given to the IPs who administered the simulator training.

Apparatus. The ASPT was used for initial conversion and A/S weapons delivery training with the A-10 serving as the criterion test vehicle. Technical references for ASPT can be found in Hagin and Smith (1974), but since the device was extensively modified for this application, it is necessary to give the major details specific to the A-10 simulation used.

The Phase I A-10 ASPT configuration physical configuration was obtained by modifying a T-37 cockpit. Although it was not possible to perfectly duplicate the A-10 cockpit, the important spatial relationships among critical instruments and controls were preserved. Because the objectives of this phase of the effort were limited, the A-10 panel required only the following instruments and indicators: angle of attack; turn and slip; clock; ADI, HSI; vertical velocity; airspeed; altimeter; engine temperature; tachometer; flap; NWS; landing gear. With the exception of the ADI and HSI which were from the T-38 aircraft, these instruments were of the type used on the T-37. The stick, throttle, and landing gear handle were locally fabricated and were nearly identical to those on the A-10. Since there was no requirement for training navigation, Instrument flight rule conditions, or emergency procedures, neither the radio aids nor any of the A-10 aircraft systems (e.g., the hydraulic system) were simulated.

Aircraft performance and handling qualities throughout the normal flight envelope were very precisely simulated. Rates of climb and descent under all aircraft loading conditions were checked against flight test data. Responses to pilot inputs were verified by duplicating the aircraft's flight test handling qualities and comparing long period longitudinal and lateral directional oscillations as well as step aileron response and response to pitch doublets.

Two visual data bases were generated. One of these represented Davis-Monthan AFB and the other, the Gila Bend Gunnery Range. Because of the limited edge capacity of the computer-generated image system (i.e., 2500-edge maximum), only Runway 12 of the air base was simulated in detail and only major operational landmarks were represented in the visual scene.

A heads-up display (HUD) unit was added to the ASPT. It consisted of an F-15 processor modified to provide A-10 symbology projected onto an A-10 combiner glass. The ASPT combiner glass was the second generation combiner glass for the A-10. These will be retrofitted to the aircraft in the near future.

In sum, although the ASPT A-10 simulation was not as complete as a full instrument training or mission simulator, the aerodynamic characteristics of the A-10 were faithfully represented, all essential instruments operated, and the computer image generation system depicted the Davis-Monthan environment and the Gila Bend Gunnery Range with reasonable fidelity. The HUD was accurately simulated, and there were automated performance measures for both conversion and surface attack training.

Syllabus Development. The prototype of the A-10 simulator training syllabus was completed in mid-April 1977. In May, this syllabus was expanded by two additional conversion sorties so that the first class received four conversion sorties prior to the first aircraft flight. The initial syllabus also included three ASPT surface attack sorties that were accomplished approximately 4 weeks after the conclusion of the conversion phase.

The modification to the first syllabus consisted of a reduction in conversion sorties from four to three and an increase in surface attack sorties from three to four. In addition, the content of the surface attack portion was slightly modified. The next syllabus further reduced the conversion sorties to two. The surface attack sorties were also reduced to this number.

At this point, it was determined that sufficient conversion training could be accomplished in two ASPT sorties of 2 hours duration, but that 4 hours of ASPT training in weapons delivery was not producing satisfactory results. To rectify this situation, the ASPT weapons delivery training was expanded by 50 percent. The final product, the syllabus in Appendix A, has two ASPT 2-hour sorties for conversion training and three ASPT sorties of 2 hours each for A/S weapons delivery training.

Procedures

As previously stated, the work effort was not completely congruent with the classical experimental model used in behavioral research. Certain aspects of this model did exist, however, and provided a framework for reporting and analyzing the results observed.

Study conditions. The number of students trained under a particular syllabus and the conversion and A/S weapons delivery sorties/hours are shown in Table 1 which presents a general schematic of the study's conditions.

Table 1. **Study Conditions**

	Number of Students	Conversion Sorties (Hours)	Conventional A/S Sorties (Hours)	Pop-Up A/S Sorties (Hours)
Class 1	6	4	3	0
		(8)	(6)	(0)
Class 2	6	3	3	1
		(6)	(7)	(1)
Class 3	5	2	1	1
		(4)	(2)	(2)
Class4	7	2	0	0
(Control)		(4)	(0)	(0)

Independent Variables. The independent variables used in the study were the number of ASPT sorties (i.e., amount of simulator training) and tasks (events) on which this instruction was received. As can be seen from Table 1, there were different levels for both independent variables—a necessary consequence of the syllabus development procedures. Thus the total N of the various subject groups is rather small and it appeared pointless to make comparisons based on classes and number of simulator training hours. However, when the unit of analysis was based on the tasks practiced, it became possible to investigate the simulator training effects in a meaningful manner.

Conversion Training Tasks. The final conversion training portion of the syllabus consisted of two sorties. Table 2 lists the content of Sortie 1 and Table 3 lists that of Sortie 2.

Table 2. **Conversion Training Sortie 1**

1. Local area orientation and familiarization
2. Takeoff; climb; level-off
3. Stall recovery procedures (familiarization only)
   a. Power-on stall (straight ahead)
   b. Power-off stall (turning)
   c. Traffic pattern stalls (low flight)
   d. Vertical stalls
4. Lazy eight; aileron roll (speed brakes closed); aileron roll (speed brakes open)
5. Loop; cuban eight; split "S"
6. Descent; straight-in approach; go-around
7. Re-entry; normal overhead pattern and approach; go-around
8. Closed pattern; normal approach; go-around
9. Closed pattern; normal approach; go-around
10. Closed pattern; normal approach; touch-and-go
11. Closed pattern; normal approach; touch-and-go
12. Closed pattern; normal approach; touch-and-go
13. Re-entry; normal overhead pattern and approach; full stop landing

Table 3. **Conversion Training Sortie 2**

1. Takeoff; climb; level off
2. Descent; SFO pattern and approach; go-around
3. Re-entry; SFO pattern and approach; touch and go
4. Re-entry; straight-in approach; go-around
5. Closed pattern; normal approach; touch and go
6. Closed pattern; no-flap overhead pattern and approach; touch and go
7. Closed pattern; no-flap approach; touch and go
8. Closed pattern; simulated single engine overhead pattern and approach; simulated single engine go-around
9. Closed pattern; simulated single engine approach; touch and go
10. Closed pattern; normal approach; full stop landing

A/S Weapons Delivery Tasks. There were six A/S weapons delivery tasks: five bombing tasks and a low angle strafe task. Table 4 presents a listing of these tasks and their related release parameters.

Table 4. A/S Weapons Delivery Tasks

Task	Dive Angle	Release Altitude	Release Airspeed	Slant Range
Dive Bomb (DB)	30	610 meters AGL	350 KIAS	1033 meters
Low Angle Low Drag (LALD)	20	457 meters AGL	325 KIAS	975 meters
Low Angle Bomb (LAB)	15	183 meters AGL	325 KIAS	529 meters
LALD Pop-up	20	457 meters AGL	325 KIAS	975 meters
LAB Pop-up	15	183 meters AGL	325 KIAS	529 meters
Low Angle Strafe (LAS)	5-15	Above 23 meters AGL	300+ KIAS	775 meters

Dependent Variables and Scoring. Two dependent variables, specific to the phase of student training, were used. In the conversion training phase, specific parameters for performance measurement were captured during student ASPT training, but corresponding hard data were not available from A-10 conversion flights. The only criterion scores possible were IP checkride grades (rating data). Therefore, the initial qualification ratings from the student checkrides given on the seventh A-10 flight were used to make comparisons between groups.

For the A/S weapons delivery phase, actual bomb plots from the ASPT and bomb scores from training flights in the aircraft were used as criterion measures. All bomb results were calculated in Circular Error Probable (CEP) instead of Circular Error Average (CEA). The CEP is the median bomb score whereas the CEA is the mean bomb score. It is believed that the CEA does not produce as representative a picture of performance since it is positively skewed by gross error bombs. Thus the CEP generates the most accurate indicator of the typical bomb score in a particular event.

All bombs dropped more than 91.5 meters from a target (gross error bombs) were given a value of 91.5 meters. Bombs scored in the ASPT receive exact readouts but those dropped from the aircraft are scored in 1.52-meter intervals. Therefore, for proper comparison, all ASPT bombs were recomputed to the closest 1.52-meter interval. All bombs dropped within 6.1 meters from the target are scored as bull's-eyes.

The score for LAS was computed using the percentage of hits per rounds fired. The percentages of all students on a particular sortie were then averaged for the purposes of comparison.

Statistical Analysis. Although a non-parametric analysis of the data from the conversion training phase was planned, the observed combination of the small *n* and score distribution pattern did not justify such action. But the situation for the A/S weapons delivery phase was quite different. In this case, there were sufficient quantitative data to do a fairly comprehensive parametric analysis. Following Lindquist (1953) six simple factorial trend analyses of variance were performed (one for each weapons delivery task). All tests were run at the 5 percent level of significance.

Results

The study results are presented separately for the conversion and weapons delivery phases.

Conversion Phase Results. At the time of the study, the conversion phase of the A-10 training course consisted of transition, formation, instrument, and Basic Flight Maneuvering. Six aircraft flights were flown during the phase and the seventh flight was an initial qualification (IQ) checkride. For purposes of comparison, only the IQ checkride grades are presented in this report. The checkride grades fall into three categories:

Q-1 Qualified with no deviations;
Q-2 Qualified with deviations; some tasks must be repeated; and,
Q-3 Not qualified; requires recheck

Table 5 gives the results of the evaluation of the conversion training phase.

Table 5. **Conversion Phase Results**

	ASPT Sorties	Failed ASPT Sorties	Failed Aircraft Sorties	IQ Grades		
				Q-1	Q-2	Q-3
Class 1	4 each	1	1	3	3	
Class 2	3 each	0	0	4	2	
Class 3	2 each	0	0	4	1	
Class 4	2 each	0	1	3	1	3

The student who failed the aircraft sortie in Class 1 also failed the ASPT sortie. The three students who failed checkrides (Q-3) in Class 4 made errors that were not instructed in the ASPT. Two of them failed to meet proper grading criterion for TACAN navigation approaches (not modeled in the ASPT), and one did not compensate properly for winds in the traffic pattern (the ASPT is taught as a no-wind environment). Thus it appears that the two ASPT sorties received were sufficient for safe aircraft transition.

Weapons Delivery Phase. The surface attack weapons delivery phase of the A-10 training course consisted of 12 sorties. The first seven sorties were conventional deliveries with 30° dive bomb (DB), 20° low angle low drag (LALD), 15° low angle bomb (LAB), and 5° low angle strafe (LAS) events. The remaining five sorties consisted of pop-up deliveries with 20° LALD, 15° LAB, and other events.

Seventeen of the students were pre-trained on these events in the ASPT. This made it possible to compare their subsequent performance on these events in the A-10 aircraft with the performance of the Control Group (seven students) when both groups accomplished these same events in the aircraft. Table 6 lists the average of the median CEP (in meters) for students and IPs on the 30° Dive Bomb event. Analysis of these data showed that the ASPT-trained students had a significantly smaller error score than did the control students.

Table 6. **30° Dive Bomb CEP (Error in Meters)**

	ASPT		Aircraft		
	IPs	Students	IPs	ASPT Students	Control Students
Sortie 1	30.5	49.4	18.9	24.4	39.6
Sortie 2		36.6		29.0	37.5
Sortie 3		34.4		24.3	30.5
Sortie 4				20.7	32.3
Sortie 5				25.9	24.1
Sortie 6				24.7	29.9
Sortie 7				25.3	21.3

This finding was repeated for the 20° LALD Dive Bomb event (Table 7). Again the ASPT-trained students had a significantly smaller CEP.

Table 7. **20° LALD Dive Bomb (Error in Meters)**

	ASPT		Aircraft		
	IPs	Students	IPs	ASPT Students	Control Students
Sortie 1	30.8	45.1	20.7	22.2	36.0
Sortie 2		42.1		23.8	36.6
Sortie 3		36.0		28.3	27.7
Sortie 4				21.9	28.7
Sortie 5				23.8	33.5
Sortie 6				23.2	28.5
Sortie 7				24.1	30.3

The trend was continued in the 15° LAB Dive Bomb event. The analysis of the data summarized in Table 8 found that the ASPT-trained students had a significantly smaller CEP.

Table 8. **15° LAB Dive Bomb (Error in Meters)**

	ASPT		Aircraft		
	IPs	Students	IPs	ASPT Students	Control Students
Sortie 1	15.2	35.1	12.2	21.6	25.9
Sortie 2		25.9		21.5	25.6
Sortie 3		34.4		15.2	24.7
Sortie 4				20.1	16.8
Sortie 5				13.1	24.4
Sortie 7				16.2	22.3

The ASPT-trained students did not prove superior, however, when the data from the 20° LALD Pop-Up event were analyzed. In point of fact, it was the control group of students who exhibited significantly better performance (Table 9). A possible explanation for this finding is related to limitations in the ASPT visual cues.

Table 9. **20° LALD Pop-Up (Error in Meters)**

	ASPT		Aircraft		
	IPs	Students	IPs	ASPT Students	Control Students
Sortie 1	29.9	45.7	22.9	34.4	33.5
Sortie 2				32.0	22.3
Sortie 3				35.4	27.4
Sortie 4				35.1	27.3
Sortie 5				36.6	25.9

In the 15° Pop-Up event, the ASPT-trained students again demonstrated significantly better performance than the control group. Table 10 presents the data that support this conclusion.

Table 10. **15° LAB Pop-Up (Error in Meters)**

	ASPT		Aircraft		
	IPs	Students	IPs	ASPT Students	Control Students
Sortie 1	22.7	27.4	10.7	18.3	22.3
Sortie 2				13.7	17.1
Sortie 3				17.7	20.4
Sortie 4				14.6	23.8
Sortie 5				12.5	13.7

The simulator training was also highly beneficial for the Low Angle Strafe event. As in the four of the five bomb events, the performance of the ASPT-trained students was significantly better than that of the control group (Table 11).

Table 11. **Low Angle Strafe (Percent of Rounds Through Target)**

	ASPT		Aircraft		
	IPs	Students	IPs	ASPT Students	Control Students
Sortie 1	66	22	70	56.5	28
Sortie 2		42.5		70	40
Sortie 3		56		71	44
Sortie 4				56	45
Sortie 5				53	48

Discussion

Conversion Training. Student classes received various amounts of ASPT conversion training, with the main concern being safe transition from the ASPT to the A-10. The evidence seems to show that two sorties with 4 total hours of ASPT conversion training is sufficient for this purpose. Two sorties seem optimal because student performance in ASPT showed little or no increase and at times slight regression during the third and fourth ASPT sorties. Most students stated that they felt two sorties were essential, but although subsequent sorties enabled them to fly the ASPT better (compensate for its characteristics), this additional training did not necessarily help them in the aircraft.

A/S Weapons Delivery Training. Inspection of the data from the first three classes indicated that three ASPT A/S sorties gave the optimum return for the amount of time invested in training. For conventional bomb deliveries, it can be seen that students and IPs have approximately a 10-meter CEP differential between the simulator and the aircraft. Probably due to the limitations of the visual simulation of depth perception cues, students and IPs drop less accurate bombs in the ASPT than in the aircraft. Therefore, trying to improve student performance in the ASPT beyond a third sortie or below the 10-meter differential may not be reasonable.

Training in the ASPT greatly improves the initial weapons delivery performance in the aircraft. ASPT weapons training appears to lower the actual CEP for the first surface attack sorties in an aircraft by approximately 7 to 8 meters. Additional benefits from simulation are accrued in safety of flight and ease of instruction. IPs would much rather instruct students on early S/A sorties who have had ASPT weapons training than students who have not. Much of the mechanical and procedural problems associated with the controlled range are also smoothed out during ASPT training, leaving more time for instructing weapon delivery techniques on the actual range.

It seems that it is more difficult to deliver bombs accurately in a pop-up maneuver in the ASPT than in the aircraft. It is believed that limited depth perception cues over the ASPT flat visual flight plane makes the entire pop-up profile more of an instrument procedure in the ASPT than it is in the actual aircraft. As a result, judging angle-off approaches based on visual cues and apex positioning makes the pop-up weapons delivery task more difficult in the ASPT than in the aircraft.

The ASPT is an excellent strafing simulator. The depth perception problems that are associated with the conventional and pop-up bombing events do not have as severe an impact on the strafing task. In the bombing events, base leg distances, base altitudes, and release slant ranges (except LAB) are larger than for the LAS event. In ASPT the greater the distance from the target, the less detail and clarity displayed by the visual system for the specific target area. In the LAS event, the release slant range is closer, which allows more detail to be placed on the targets. The targets are also built up vertically (parachutes strung between 9-meter-high posts), thus increasing depth perception cues. Even though the targets are still not clearly defined at open fire ranges in the ASPT, the lack of good depth perception cues is not as critical as in the bomb events.

Student LAS performance in the ASPT is much closer to aircraft results than in the bombing events. This could be partially due to the reduced importance of depth perception cues and partially due to the fact that LAS demands less adherence to specific aircraft delivery parameters than do the bomb events. The A-10 30mm gun ballistic characteristics allow wide latitude in dive angle, altitude, and airspeed. Barring extremely gross parameter deviations, the rounds impact where the gun cross indicates. Students get good strafe scores if they place the gun cross on the target and fire. Thus it is possible to get good scores with less well developed motor skills. It should be noted that, in the initial sortie in the ASPT, the students scored 22% hits. The result for the control group on the first A-10 sortie was 28%; a figure very close to the initial ASPT result. Furthermore, there is an almost perfect correlation between the students' strafing performance on the third ASPT sortie and in the initial aircraft sortie. This finding is confirmed by the IP data. IPs shoot 66% in ASPT and 70% in the aircraft, showing the close correspondence between performance in the simulator and in the aircraft.

Conclusions

For the conversion phase of training, it is believed that two ASPT sorties of 4 total hours is optimum for most students. With this amount of training, the ASPT has proved to be a device that permits UPT graduates to safely transition to the A-10 aircraft.

For the A/S weapons delivery phase of training, three ASPT sorties totaling 6 hours has been found to be highly effective. ASPT weapons delivery training lowers actual student CEP on early aircraft surface attack sorties by approximately 7 to 8 meters. Additional benefits are found in safety of flight and ease of instruction on the controlled range. Possibly due to inadequate depth perception cues in the ASPT visual system, students and IPs deliver bombs more poorly in the ASPT than in the aircraft. This difference in performance is seen as a system limitation for the current ASPT configuration.

Pop-up training in the ASPT does not appear to have the same benefit for the students as does training in conventional deliveries and LAS. More research must be done in this area before firm conclusions can be reached on the validity of this finding.

The ASPT is a very good simulator for strafe training. The final strafe performance of students in the trainer very nearly approximated their initial strafe performance in the aircraft. In addition, students who did not receive ASPT training initially perform in the aircraft at close to the same level as students in their initial ASPT strafe training (about 25%).

In sum, the ASPT has produced excellent results in both the A-10 conversion and weapons phases. Research will be continued to apply ASPT "lessons learned" to dedicated weapon system simulators with advanced technology visual and flight dynamics simulations. Based on the results seen to date, the value of such future generation devices in enhancing student training and performance should be very great indeed.

III. PERFORMANCE MEASUREMENT

There is no question as to the necessity of evaluating student performance, but the methods by which this is accomplished may vary widely. In the ASPT portion of the present study, two rather sharply contrasting approaches were used to assess proficiency. The first, IP judgment, is the conventional Air Force technique used to rate piloting skill from UPT through combat crew training. The second, possible in simulators and some instrumented aircraft, is based on measurement of physical parameters reflecting aircraft control and vehicle states within the flight envelope.

As concerns the conversion training phase, there were two reasons why the development of quantitative measures of student performance were deemed important. First, the training in ASPT was an unknown quality. Because of the criticality of the conversion phase of training it was believed that additional measures of proficiency (even if redundant with IP judgment) would add confidence to the determination that the student was, in fact, capable of soloing the A-10. Second, the generation of algorithms allowing "automated" performance measures yielded a product that could be directly transferred to the A-10 OFT when it came on line. These measures would then serve an additional "quality control" function for the OFT instructional program.

The need for quantitative assessment of student performance in the ASPT weapons delivery phase of training is obvious. The ability to drop bombs and strafe targets can be known only if it can be measured.

The measures utilized in the ASPT may be categorized into four types: (a) measurements of deviation of steady-state flight parameters, (b) measurement of rates, accelerations, and control inputs that reflect how smoothly a maneuver was performed, (c) captured parameter values during a critical instant of flight, and (d) indicators that flagged procedural and/or safety errors.

Type 1. Measures of steady-state parameters. The ability to maintain specific steady-state flight conditions in certain maneuvers provides a meaningful measure of a pilot's performance of that maneuver. In the ASPT, the relevant parameters can be specified for a maneuver, and deviations from a base value (ideal) can be measured. For each parameter used, a base value and an upper and a lower error tolerance (gross deviation from the base value) were specified. For the maneuvers flown in the conversion training, a computational routine called Standard Profile One automatically calculated the deviation values for each parameter specified using a sample rate of five times per second. As a result of this process, seven values were calculated for each parameter. These values are listed in Table 12.

Table 12. Standard Profile 1

Computer Code	Calculated Values for Each Parameter
1	Mean
2	Root Mean Square
3	% High
4	% On
5	% Low
6	Maximum Deviation
7	Minimum Deviation

Although any selected value sometimes provided highly useful information on the student's performance of a given maneuver, the level of detail was too "fine-grained" for the average IP to manage. To overcome this problem, using the Code 4 data, a single total score was computed that indicated the percent of time that all parameters measured were simultaneously within the tolerance band. This score was extremely valuable in the evaluation process and was extensively utilized.

Type 2. Measures of maneuver smoothness. A secondary measure of performance was based on how smoothly the student flew the maneuver. The "smoothness profile" measured rates and accelerations about all three flight axes and pilot control inputs. A computation routine called Standard Profile Two (see Table 13) performed the required calculations 30 times per second. By reviewing rate and acceleration changes, it was possible to assess "smoothness" during any segment of a maneuver.

Table 13. Standard Profile 2

	Variable Name	Physical Basis
1	Aileron Power	Lb - Degrees/Second
2	Aileron RMS Position	Degrees
3	Aileron RMS Movement	Degrees/Second
4	Aileron Reversals	N/Second
5	Roll RMS Rate	Degrees/Second
6	Roll RMS Acceleration	Degrees/Second^2
7	Elevator Power	Lb - Degrees/Second
8	Elevator RMS Position	Degrees
9	Elevator RMS Movement	Degrees/Second
10	Elevator Reversals	N/Second
11	Elevator Ave Trim Force	Lb
12	Elevator RMS Trim Force	Lb
13	Pitch RMS Rate	Degrees/Second
14	Pitch RMS Acceleration	Degrees/Second^2
15	Rudder Power	Lb - Degrees/Second
16	Vertical Velocity RMS Rate	Degrees/Second
17	Vertical Velocity RMS Accel	Degrees/Second
18	Throttle RMS Movement	Degrees/Second
19	Stick RMS Movement	Degrees/Second
20	Number of Samples	N

Type 3. Parameters captures. Captures were used to record the values of any set of specified parameters at the instant a specific action occurs. For example, at the instant of bomb release, airspeed, altitude, g-loading, dive angle, heading and bank were captured. Bomb impact information (i.e., miss distance and angular position) and strafe scoring were computed by a special A-10 ballistics subroutine that extrapolated the trajectory of the bomb or bullets from the flight parameters at the moment the bomb release button was pressed or the strafe trigger squeezed.

Type 4. Error Flagging. Finally, logical (i.e., True or False) error flags were set if specified procedural or safety errors were committed by the pilot. For example, a flag was set True if the pilot attempted to land in an improper configuration (e.g., wheels up).

Table 14 gives a complete list of the ASPT maneuvers taught in the A-10 training syllabus and shows the type of performance measurement associated with each maneuver.

Table 14. A-10 Performance Measures

Conversion Tasks	Type
Takeoff, climb and level off at 15,000	1,2,3,4
Steep turns	1,2
Slow flight	1,2,3,4
Lazy 8, aileron roll (clean, 40% speedbrake)	2,3,4
Loop, Cuban 8, splits	2,3,4
Descent, straight-in, go-around	1,2,3,4
Re-entry, normal overhead pattern, go-around	1,2,3,4
Closed, normal overhead, touch and go	1,2,3,4
Closed, no flap, touch and go	1,2,3,4
Closed, simulated single engine, touch and go	1,2,3,4
Closed, simulated single engine, single engine go-around	1,2,3,4
Closed, normal overhead, full stop	1,2,3,4
Air-to-Surface Tasks	
Takeoff, climb, level off to 6,000	1,2,3,4
30 degree dive bomb	1,2,3
Low angle, low drag bomb	1,2,3
Low angle bomb	1,2,3
Low angle strafe	1,2,3
Low angle low drag pop-up	2,3
Low angle pop-up	2,3
Low angle strafe pop-up	2,3

During the course of training, a record of the student's performance was available in a computer printout format after the completion of each maneuver or task. To supplement this information, an Active Maneuver "page" was automatically displayed on a console cathode ray tube that enabled the instructor or researcher to actively monitor the student's performance. This "page" contained all of the measurement information in the computer printout and was constantly present and updated. If desired, a hardcopy of the Active Maneuver "page" could be obtained to provide feedback to the subject or to use as a debriefing aid.

The IPs found the proficiency measures to be extremely useful. The real-time display of quantitative information in digital and graphic form provided a valuable adjunct to their role as student evaluators. The proficiency measures were most helpful in allowing the IP to make the determination of when a maneuver had been satisfactorily mastered and where further practice was required. Additionally, the specific elements of a task or maneuver that was being improperly executed could be identified, a factor which was highly beneficial in the training process itself.

Examples of the computer printout and its associated active maneuver page are given in Figures 1 and 2.

```
01NOV78      10:36:11      ASUPTSDS    SYSTEMS REAL-TIME MONITOR-6 ___0

STUDENT ID:
EXER SEG
IP ID
COCKPIT     A
MIS. NO.              4
DATE       01NOV78
SEG NO.               4
INIT NO.             68
TIME         9:49:36
WINDS      0.0000E 00   0.0000E 00
TURBLNCE   0.0000E 00
PASS NO1   1.0000E 00
TTL SCR1   3.3770E 01
BAS ALT1  -3.3271E 01   6.5448E 01   0.0000E 00   1.0000E 02   0.0000E 00
           5.1950E 01  -1.1505E 02   0.0000E 00
BAS A/S1   1.5450E 01   1.6313E 01   6.6292E 01   3.3706E 01   0.0000E 00
           2.2071E 01   0.0000E 00   0.0000E 00
MX-MN GS   4.0545E 00  -7.5520E-02
RELEASE1   1.9596E 03   3.5125E 02   3.3704E 01   3.5494E 02   8.3256E-01
           4.9109E 01   9.2496E-01  -3.1755E 01
SCORING1   2.9900E 02   9.6907E 01
PULLOUT1   1.1951E 03   5.5019E 00   1.2000E 00
SMOOTH 1   4.6081E-01   5.9179E 00   1.5936E 01   4.6294E-01   1.2137E 01
           1.4336E 01   4.3633E 00   2.4905E 00   4.7955E 00   4.4925E 00
          -5.5117E 00   4.3835E 00   5.3172E 00   3.9431E 00   4.0573E-03
           2.0140E 00   1.9056E 00   2.4071E 01   1.6542E 01   4.6010E 03
PASS NO2   2.0000E 00
TTL SCR2   1.0000E 02
BAS ALT2   7.7431E 01   8.2529E 01   0.0000E 00   1.0000E 02   0.0000E 00
           1.1242E 02   0.0000E 00   0.0000E 00
BAS A/S2   1.5042E-02   5.1230E 00   0.0000E 00   1.0000E 02   0.0000E 00
           4.7532E 00  -5.0779E 00   0.0000E 00
MX-MN GS   3.5400E 00  -2.0087E-01
RELEASE2   1.8286E 03   3.5251E 02   3.0539E 01   3.4091E 02   5.2795E-01
           9.0275E 01   9.5590E-01  -2.9340E 01
SCORING2   3.6900E 02   5.0057E 01
PULLOUT2   1.0960E 03   4.8878E 00   1.4000E 00
SMOOTH 2   1.0617E 00   7.3236E 00   2.2931E 01   8.1605E-01   1.4527E 01
           1.9276E 01   3.4532E 00   2.5261E 00   6.4229E 00   4.6595E 00
          -6.6274E 00   1.0324E 01   6.5910E 00   5.1559E 00   8.4383E-03
           2.8805E 00   2.3712E 00   1.9355E 01   2.3014E 01   1.3970E 03
PASS NO3   3.0000E 00
TTL SCR3   5.4000E 01
BAS ALT3  -2.0092E 02   2.2339E 02   0.0000E 00   5.7000E 01   4.3000E 01
           0.0000E 00  -3.6510E 02   0.0000E 00
BAS A/S3   9.1563E 00   1.0691E 01   3.1070E 01   6.9000E 01   0.0000E 00
           1.4931E 01  -4.2070E 00   0.0000E 00
MX-MN GS   4.0704E 00  -5.3312E-01
RELEASE3   1.8604E 03   3.5028E 02   3.2539E 01   3.3681E 02   8.7809E-01
           9.0057E 01   9.5596E-01  -3.0874E 01
SCORING3   2.6500E 02   9.9316E 01
PULLOUT3   1.0199E 03   4.5876E 00   1.2000E 00
SMOOTH 3   1.3914E 00   7.5657E 00   2.7965E 01   8.8609E-01   1.5729E 01
           2.5405E 01   7.8578E 00   2.6596E 00   7.4534E 00   3.0525E 00
          -5.6658E 00   1.1917E 01   7.0650E 00   6.1025E 00   1.2963E-02
           2.8125E 00   2.4424E 00   1.7474E 01   2.8956E 01   1.3850E 03
PASS NO4   4.0000E 00
```

Figure 1. **Computer printout.**

B-107

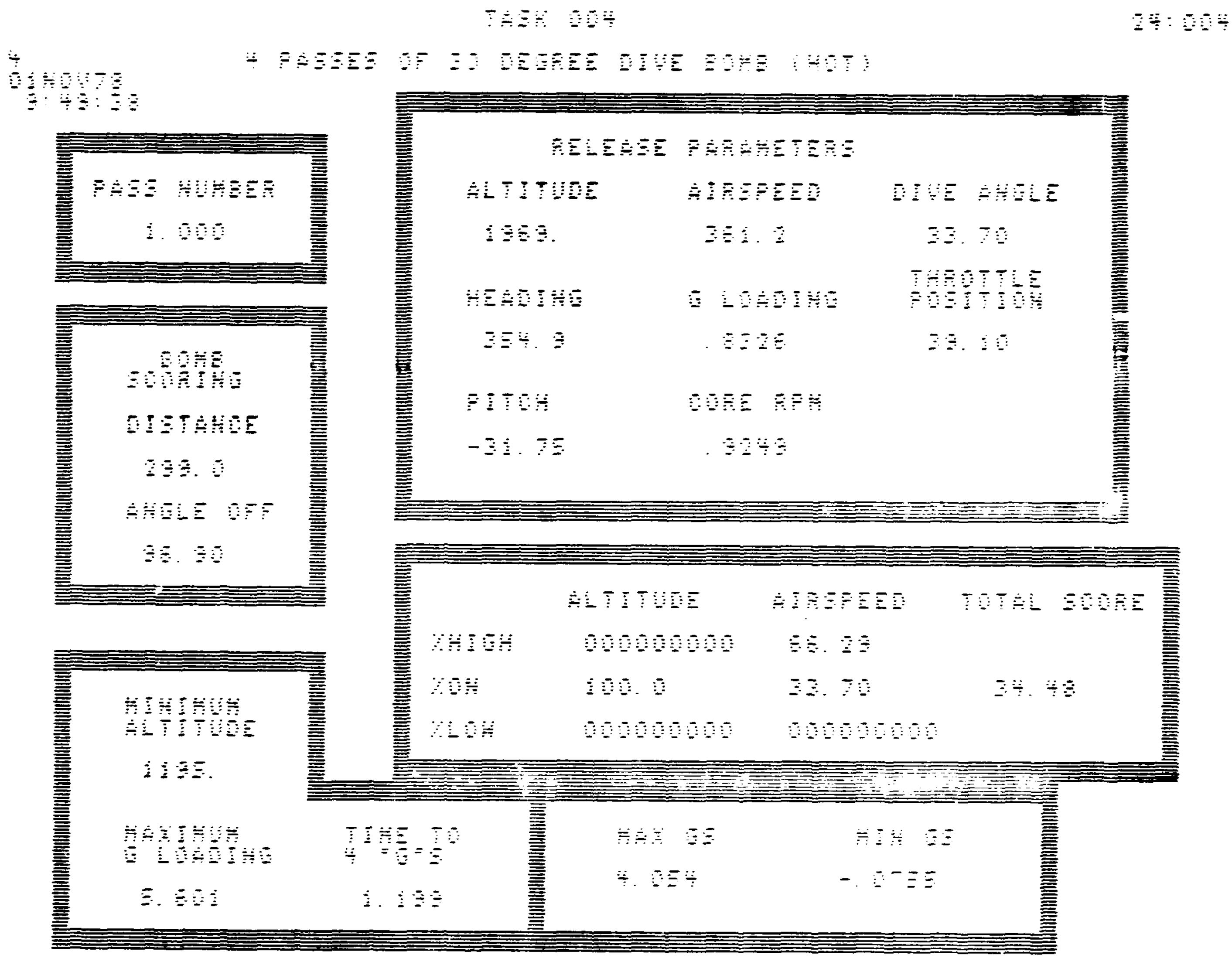


Figure 2. Active maneuver page.

IV. INSTRUCTOR/OPERATOR STATION DESIGN

Introduction

Full-mission A-10 flight simulators are being procured by the Air Force Tactical Air Command (TAC) for surface attack weapons delivery training in the low-altitude, high-speed, terrain-following flight regime. These simulators will be used to train pilots to accomplish a variety of weapons delivery maneuvers. The full-mission capability of the simulation will also permit training of the major flight categories, including basic contact flight, aerobatics, formation flight, navigation, and instrument flight.

Flight instruction in the training missions will be conducted by an IP located at the simulator instructor/operator station (IOS). The functions of the IP are to monitor and evaluate the performance of the student pilots and to control the conditions of training. Displays will be provided at the station for the monitoring and evaluating functions, and controls will be incorporated for the control function. Operation of the simulation system will also be accomplished at the station. Operator functions will include system control, mission selection, initiation of instructional training features, and control of the student data system. The controls and displays essential to the performance of these operations will be provided.

In order for the IP to effectively manage the instructional process and the operation of the simulator, the IOS must contain the controls and displays to support all of the training and operational capabilities anticipated for the simulator. Furthermore, the controls and displays should be arranged in such a fashion as to provide an optimum interface between the simulator equipment and the instructor.

Although the training and operational capabilities of the A-10 flight simulators have been established, the IOS controls and displays required to support these capabilities have not been identified. For this reason, a human engineering design study was conducted. The objectives of this research effort were (a) to determine the IOS control and display requirements, (b) to identify a logical and convenient arrangement of controls and displays, (c) to define an effective workplace layout, and (d) to develop an IOS design consistent with these requirements.

The human engineering design study was conducted in conjunction with the A-10 surface attack and conversion training program. Although the ASPT IOS was not specifically designed for A-10 training applications, it served as a baseline in this study for the determination of the control and display requirements for an A-10 simulator IOS. This was accomplished through the observation of the IPs during the training sessions and the application of a questionnaire survey form that was administration to each IP following the training sessions. These data collection methods were used to identify deficiencies in the design and operation of the ASPT IOS for A-10 training and to obtain recommendations for correcting them, to determine the controls and displays used during flight instruction, and to specify the controls and displays that could be added to the instructor station to enhance its instructional effectiveness. From the analysis of the data that were obtained, an engineering design of an A-10 simulator IOS was developed.

Methodology

Subjects. The subjects were A-10 IPs from the 355th Tactical Fighter Wing, Davis-Monthan AFB, Arizona, who participated in the A-10 simulator training in the ASPT.

ASPT Instructor/Operator Station. Instruction of the A-10 flight training missions was conducted at the combined advanced/conventional instructor/operator station (IOS) of the ASPT simulation system. The combined station is pictorially illustrated in Figure 3. The area at the left is

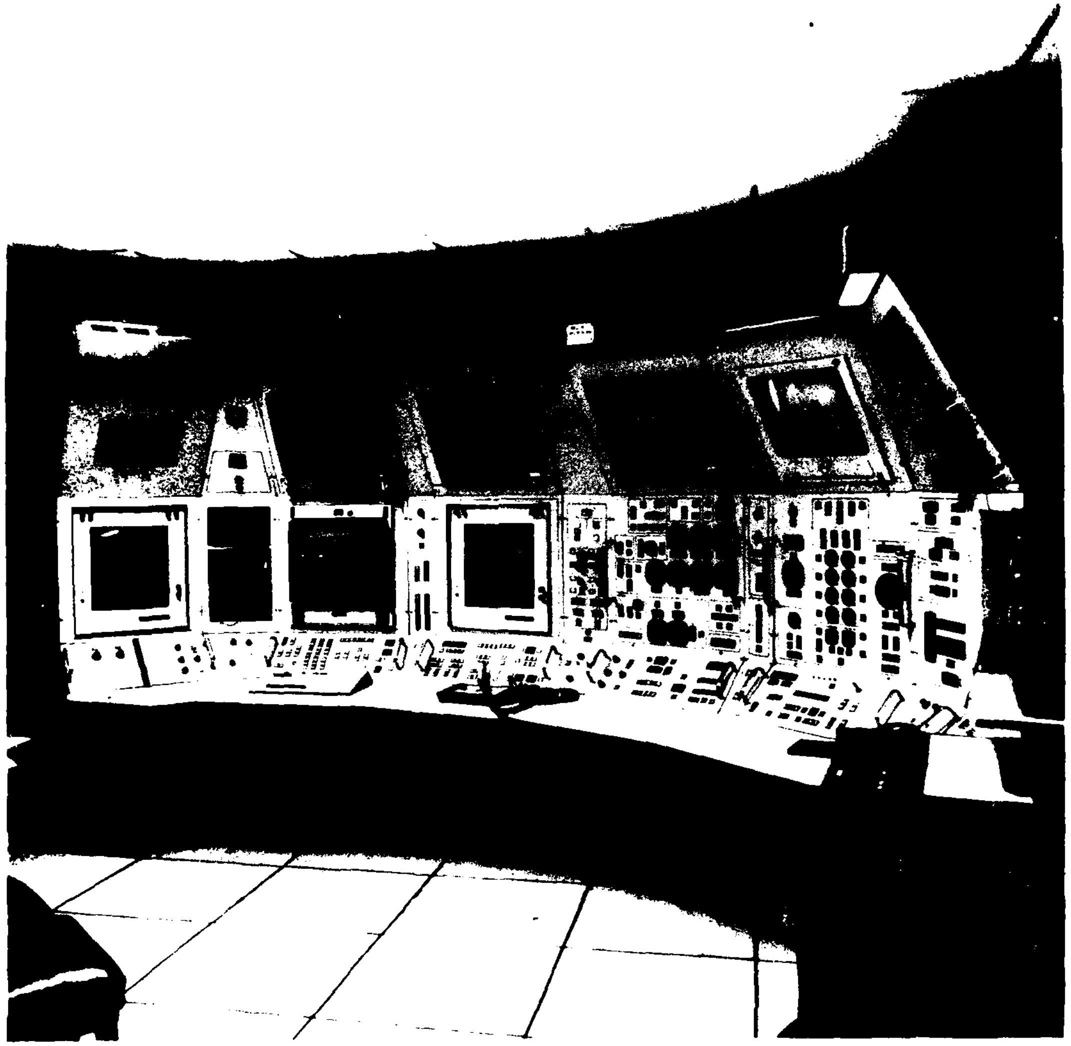


Figure 3. **ASPT advanced/conventional IOS.**

the advanced portion of the station: the conventional portion of the station is at the right. The station is arranged in a semi-wraparound fashion, permitting easy access to all panels and their associated controls and displays.

The advanced station (Figure 4) is comprised essentially of four CRT displays (two alphanumeric and two graphic), pushbutton switches for CRT assignment and content-control, a control stick that enables the instructor to "fly" the simulated aircraft, a keyboard for simulator computer control, and a variety of switches for control of the simulator motion and visual systems, station lighting, aircraft sound, microphone and speaker, and emergency system shutdown. CRT pages can be called-up on any CRT compatible with the type of page (alphanumeric or graphic). Hardcopy of any alphanumeric page can be obtained at the advanced station for instructor review and student debriefing.

In the A-10 simulator training missions the alphanumeric CRT pages, collectively, replicated the flight data provided at the conventional station and provided an operator interface with the advanced instructional simulator features (see Section I of this report). The graphic CRT pages included a cross-country navigation map and an airfield representative of Davis-Monthan AFB for the conversion training missions and a target approach and dive angle display and a bomb circle for the surface/attack training missions. Student pilot flight performance scores obtained from the automated performance measurement system and weapons delivery scores were provided in the alphanumeric and graphic CRT pages.

The conventional station (Figure 5) is comprised of the controls and displays that enable the instructor to monitor the simulated aircraft systems, act as a ground crew when preparing the simulator for flight, control fuel loading or unloading from each fuel tank as required, and set the appropriate environmental conditions prior to each mission. Communication facilities provided at the station allow the instructor to function as ground control, tower operator, forward air controller, or a general radio operator.

The two large centermost panels in Figure 5 are representative of the instrument clusters viewed from the pilot's position in the cockpit. Indicators, readouts, and repeater instruments repeat or reflect the status of the on-board aircraft systems. The arrangement of the indicator/repeater instruments and the type of instruments on the station panels, however, does not correspond to the arrangement and type of instruments used in the actual A-10 aircraft cockpit. The communication and environmental controls/displays are at the area on the right of the station.

Controls are provided at this station with which the instructor can insert simulator malfunctions, operate the student data recording systems, initiate simulator control, and adjust the in-cockpit closed circuit television (CCTV) camera. Additionally, there are controls that duplicate those at the advanced station, namely, the controls for aircraft sound, console lighting, microphone and speaker, and emergency system shutdown.

Three video monitors are included in the advanced/conventional station and are positioned across the top as shown in Figure 3. The rightmost is a CCTV monitor that enables the instructor to observe the in-cockpit activities of the student pilot. The center and left video monitors are slaved to the CRT mosaic comprising the ASPT visual system. This arrangement permits the instructor to view the visual scene as it appears to the student pilot in the cockpit.

Data Collection Methods. Two methods were used to determine the instructor station requirements for A-10 simulation training: a questionnaire survey and the direct observation of the IPs during the training missions. The questionnaire was designed to obtain a variety of data having application to the development of an A-10 simulator IOS. The first use of the questionnaire was to determine what IOS controls and displays were used by the IPs during training. For this evaluation,

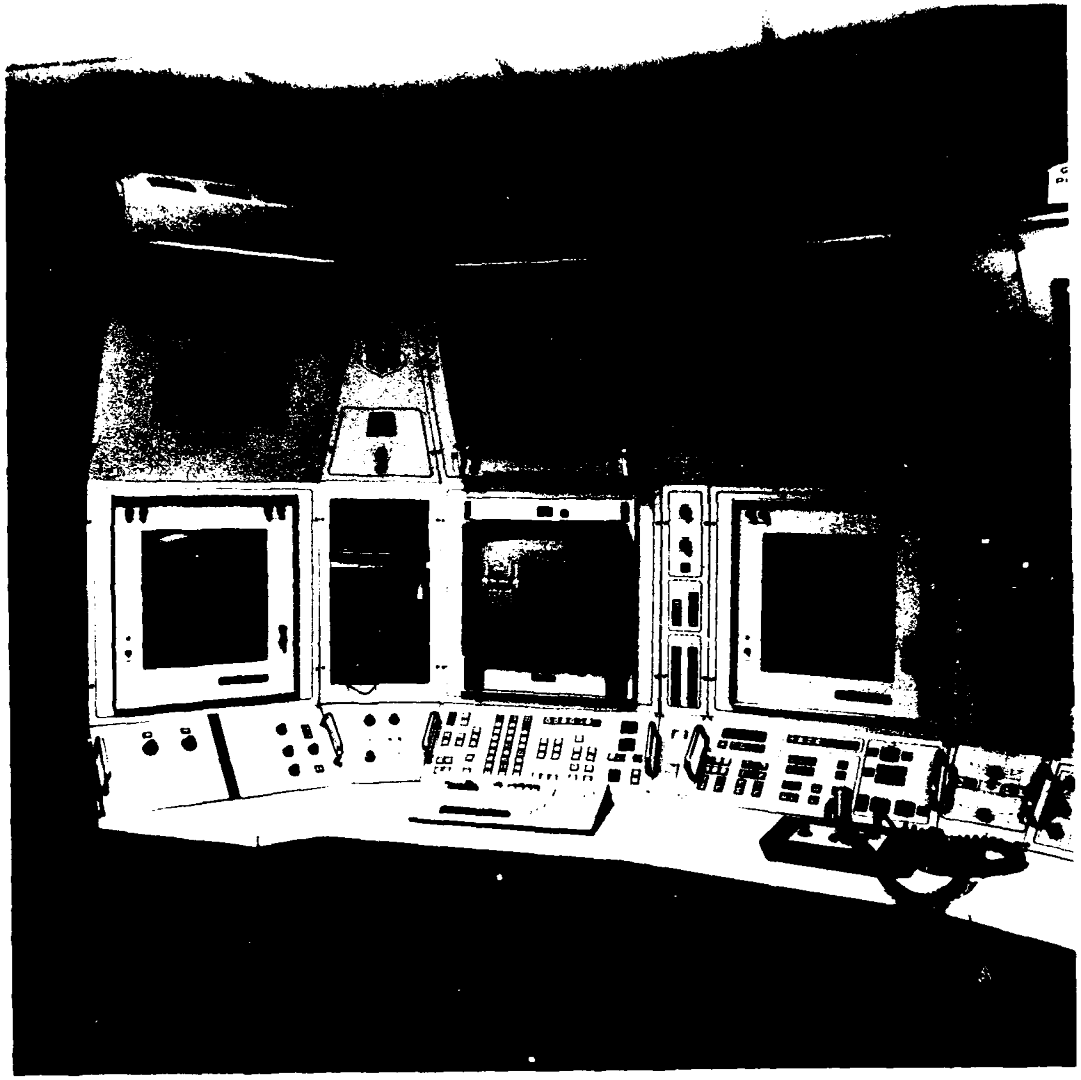


Figure 4. **ASPT advanced IOS.**

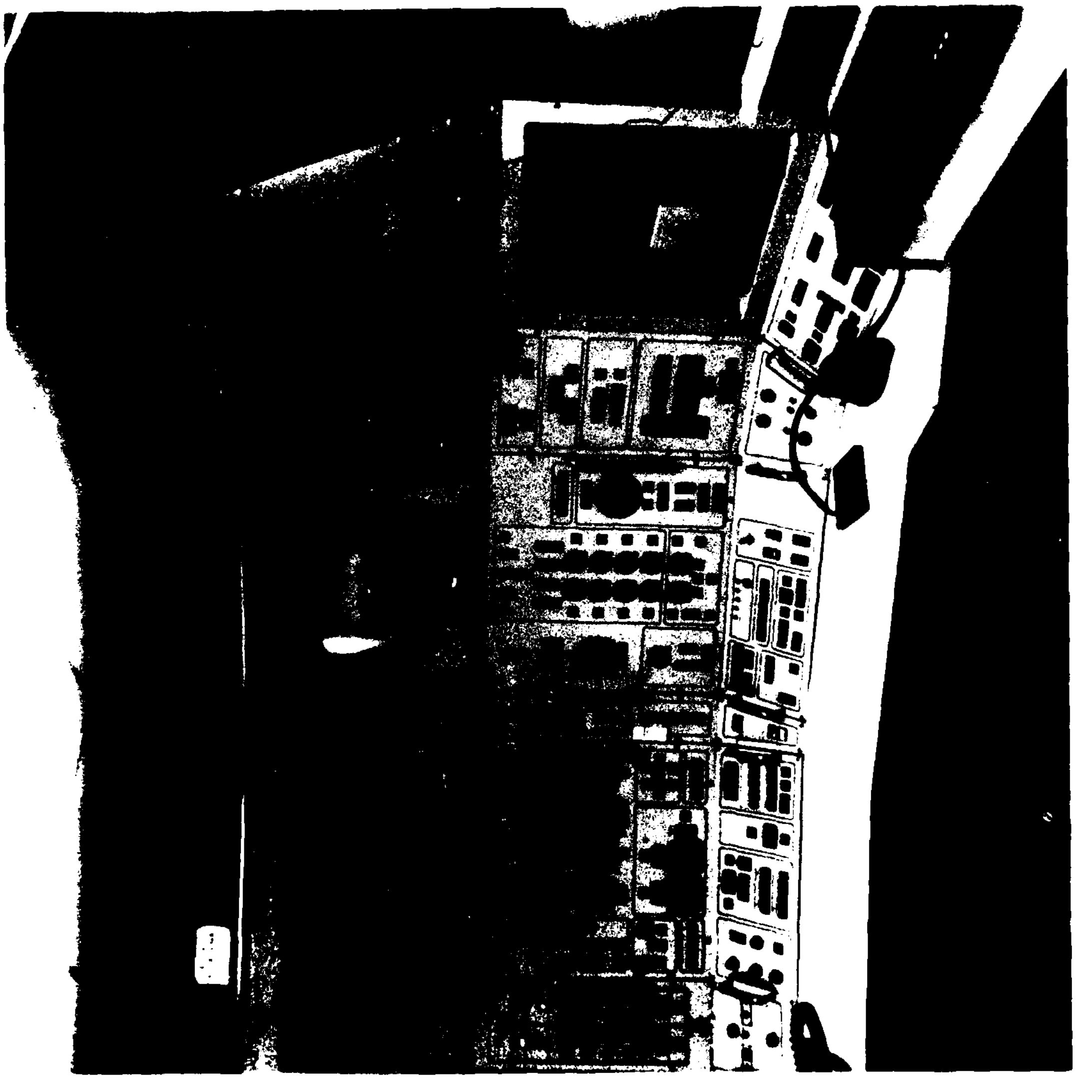


Figure 5. ASPT conventional IOS.

detailed drawings of the IOS were incorporated in the questionnaire. The IPs were asked to check those controls and displays they had used. Second, the questionnaire asked if there were any controls and/or displays that could be added to the IOS to enhance its instructional effectiveness for A-10 training. The IPs were requested to specify the preferred design, location, and operation of the controls and displays they recommended. Third, the questionnaire was used to identify deficiencies in the design and operation of the ASPT IOS for A-10 training. When deficiencies were reported, the IPs were requested to submit recommendations for correcting them. The specific areas considered in the definition of IOS deficiencies included the following:

1. Layout of controls and displays.
2. Control and display coding, such as color, labeling, lighting, shape, and size.
3. Readability and visibility of controls and displays.
4. Control/display compatibility.
5. Functional grouping of controls and displays.
6. Identifiability and interpretability of controls and displays.
7. Control sequences.
8. Control force gradients and displacement characteristics.
9. Information feedback following control activation.
10. Alphanumeric CRT character legibility and discriminability.
11. Alphanumeric CRT hard copy.
12. Graphic CRT resolution and detail.
13. Alphanumeric and graphic CRT content and format.
14. Visual scene and CCTV monitors.
15. Communications and sound effects.
16. Work place environment including lighting levels, noise levels, and ambient temperature.
17. Workplace dimensions and clearances.

In addition to the application of the questionnaire, the IPs were observed by the experimenter during the training missions. This data collection method was implemented in order to document any problems that the IPs encountered in the use of the simulator IOS and that were not addressed in the questionnaire.

Procedure. A questionnaire form was distributed to each IP participating in the A-10 surface attack and conversion training. The IPs who were involved in both phases of simulator training were administered separate copies of the questionnaire. This procedure was followed because of the potentially different IOS control and display requirements for surface attack and conversion training. The questionnaire was given to the IPs prior to the first training period. They were asked to look it over to familiarize themselves with its content. When the training for the particular class was finished, the IPs were requested to complete the questionnaire and return it to the experimenter. The experimenter was available while the questionnaires were being filled out to clarify any of the questions and to record any impressions the IPs may have had concerning the IOS that were not touched upon in the questionnaire.

Prior to the beginning of the initial training periods the IPs were asked to identify verbally any difficulties they encountered at the IOS during the training missions. The experimenter was seated at the IOS and recorded the IPs comments. Additionally, the IPs were briefed on the purpose and scope of the data gathering activity.

Results and Discussion

A total of 12 questionnaire forms were completed and returned. Of these, seven respondents had participated in conversion training, one in surface attack training, and two in both phases of training. Table 15 depicts the training phase of each respondent, along with their accumulated A-10 flying time and total hours as an A-10 IP.

Table 15. **Instructor Pilot Experience**

Phase of Training	IP No.	A-10 Flying Experience (Hr)	A-10 IP Experience (Hr)
Conversion	1	150	50
	2	280	200
	3	250	175
	4[a]	180	100
	5	200	40
	6	200	150
	7	250	200
	8[b]	365	250
	9	130	60
Surface	1	250	210
Attack	2[b]	365	250
	3[a]	180	100

[a]Same IP.
[b]Same IP.

The questionnaire data were analyzed in terms of the three major response categories: IOS control and display use, recommended control and display additions, and IOS design and operational deficiencies.

IOS Control and Display Use. The IOS controls and displays that were used during transition training and surface attack training and the number of respondents who used them are shown in Table 16.

Table 16. **Frequency of IOS Control and Display Use**

Indicators	Type of Training: Conversion	Surface Attack
Airspeed	9	3
Heading	9	3
Attitude	9	3
Turn and Slip	6	3
Altitude	9	3
Course	6	[illegible]
Climb	9	
Acceleration	9	[illegible]
Engine Instruments	9	[illegible]
Fuel Gross Weight	9	
Speed Brakes	9	[illegible]
Flaps	9	3
Gear	9	[illegible]
Toe Brakes	2	[illegible]
Nose Wheel Steering	1	[illegible]
RMI	2	
DMI	1	[illegible]
Outside Air Temp	1	[illegible]
Digital Parameter Read	2	
Timer	[illegible]	
Video Monitors		
Visual Scene (Forward View)	9	[illegible]
Visual Scene (45° to 90° View)	6	
CCTV	9	
CRTs		
Graphic (Airdrome)	9	NA
Graphic (Strafe Pattern)	NA	
Graphic (Bomb Circle)	NA	[illegible]
Alphanumeric (HUD Parameters)	NA	3
Alphanumeric (Performance Data)	9	3
Console Speaker	9	3
Communications		
Console Speaker	9	3
Controls		
Console Mike	9	3
Speaker Volume[a]	1	0
Aircraft Sound[a]	2	1
CCTV	1	0
CRT Display Location[a]	1	1
Problem (Freeze)[a]	0	2
Video Monitor[a]	6	2

The displays that were critical to the A-10 simulation training are apparent in the table. They were the primary flight instruments, aircraft system state indicators (i.e., speed brakes, flaps, and gear), alphanumeric and graphic CRT displays, video monitors and communications system. As the table suggests, few of the existing IOS controls were used, and only by a small number of IPs. It should not be assumed, however, that the essential control capabilities for A-10 simulator training are limited to these functions. There are two reasons why so few IOS controls were used. First, the majority of control operations were performed by the operator personnel. Second, the training syllabuses did not require IP control inputs, such as malfunctions, meteorological conditions, and radio frequencies.

Recommended IOS Control and Display Additions. Several displays were recommended for the IOS to enhance its operational effectiveness. These displays and the number of respondents recommending them are identified in Table 17.

Table 17. **Recommended IOS Displays**

Respondents Display	Conversion	Surface Attack	Comments
Glide Path	3	N/A	Include aircraft trail on graphic CRT for flight history.
Touchdown Point	1	N/A	Distance (Feet from threshold)
Crash Condition	1	0	Cause of crash feedback.
A/C Aimpoint (Velocity Vector)	8	2	Superimpose on visual scene monitor.
Repeater HUD	9	3	Prefer superimposition on visual scene monitor
Weapons Release	N/A	3	"Pickle" indicator on visual scene monitor.
Stall condition	2	0	Indicate stall
Stick Shaker	1	0	Indicate imminent stall condition.
Throttle Position	1	1	Throttle setting indicator.

An IOS repeater A-10 heads-up display (HUD) was unanimously recommended. The respondents indicated that it would be a particularly valuable aid for weapons delivery training because it would enable them to observe the placement of the HUD pipper at the point of weapons release. The HUD symbology should be superimposed on the forward view visual scene monitor, analogous to the manner in which it appears in the aircraft. A velocity vector symbol and a weapons release "pickle" indicator should also be incorporated in the monitor, superimposed on the visual scene. A pickle indicator would enable the IPs to identify the weapons release point so they could determine the aimpoint or projected impact point of the aircraft with a velocity vector symbol.

Several respondents recommended a glidepath indicator for use during GCAs. This could be accomplished with a CRT providing both glideslope and advised in order to depict the flight history. Other information displays were recommended, but they were not consistent choices of the respondents. These included displays for the touchdown point, crash condition, stall, stick shaker, and throttle position.

The respondents indicated that the control capabilities provided by the ASPT IOS were adequate for the training tasks. Consequently, no additional controls were suggested.

IOS Control and Display Deficiencies. A number of IOS control and display deficiencies were reported by the questionnaire respondents. The display deficiencies are identified in Table 18 along with the frequency they were observed.

Table 18. **IOS Display Deficiencies**

Display Deficiency	Respondents		Comments
	Conversion	Surface Attack	
Display Location	9	3	Arrange flight instruments as they are in the aircraft
Flight Instruments	9	3	Use A-10 instrumentation.
Hard Copy	2	3	Provide hard copy capability for graphic CRT.
Alphanumeric CRT	5	1	CRT characters are too small and cluttered.
Instrument Lighting	1	0	Light level was too low.
Graphic CRT	2	1	Airfield/navigation map lacked sufficient detail.

The questionnaire revealed that all the respondents found the arrangement and type of IOS flight instruments deficient for A-10 simulator training. They consistently suggested that the instruments be arranged just as they are in the aircraft. This would facilitate instrument cross-check and would eliminate the need for learning the location of the various displays. Additionally, the respondents preferred actual A-10 flight instruments for the IOS, since they are most familiar with them.

The absence of a hard copy capability for the graphic CRTs proved to be a notable IOS deficiency. The graphic portrayal of the gunnery range bomb circle and the relative position of the bomb impact points for weapons delivery training and the ground track of the aircraft in conversion training could not be hard copied for use in the pilot debriefings following training. The respondents indicated that weapons delivery graphic CRT hard copies would have been especially useful in the surface attack training debriefings.

The alphanumeric CRTs were deficient in two respects: the CRT characters were too small and the displays were excessively cluttered. These limitations interfered with the efficient retrieval of IOS information by the flight training instructor. The root cause of these problems was the relative distance between the CRTs and instructor. Additionally, several respondents suggested that the ground maps lacked sufficient detail for effective flight training. They recommended that the final approach course and relevant terrain features be included in the maps, such as mountains, golf course, and tennis courts.

The observed IOS control deficiencies are documented in Table 19. The basic problem underlying the various deficiencies was inaccessibility of the controls. Consequently, these deficiencies can be corrected simply by locating the controls within reach of the instructor.

Table 19. **IOS Control Deficiencies**

Control Deficiency	Respondents		Comments
	Conversion	Surface Attack	
Crash Override/Reset	1	2	Move controls to IP location.
Instructional Features	2	1	Move control to IP location.
Initial Conditions	2	1	Move controls to IP location.
Microphone	1	1	Mike cord in poor location.
Emergency Communications	2	0	Provide more convenient location.

A-10 IOS Design

The final objective of the human engineering design study involved the development of a configuration for the A-10 IOS consistent with the control and display requirements for the various instructional and operational tasks in A-10 pilot training. The IOS design concept is provided in Figure 6 and the function of each IOS panel is identified.

In general, the IOS features seven CRTs, A-10 repeater instruments, a variety of controls and indicators, and a hardcopy unit. Three of the CRTs are visual monitors. The centermost monitor provides the forward-view visual scene with a superimposed repeater heads-up display (HUD). The two flanking monitors are used to display the visual scene to the left and right of centerline at angles of 45°, 90°, 135°, or 180°, as selected by the IP. Either of these two CRTs can serve as an in-cockpit, closed circuit TV (CCTV) monitor. The remaining four CRTs are graphic displays. A number of graphic CRT pages have been devised to support the training missions anticipated for the simulator which can be called-up on any of these displays at the discretion of the IP. Actual A-10 repeater instruments for the primary flight parameters are located below the forward-view visual scene monitor. These instruments are flanked by the left and right aircraft console instruments and indicators. The arrangement of these instruments is the same as in the actual aircraft to facilitate instrument cross-check. The "g" meter and angle-of-attack indicator are provided in the panel to the left of the forward-view visual monitor; the compass and canopy status lights are on the right panel. An assortment of controls are provided at the IOS for IP control of the CRT content and page assignments, IOS lighting, aircraft sound, training features, CCTV, communications and system start, set-up, and shutdown. A CRT hardcopy unit, with an automatic and manual capability, has been included in the IOS design and is located in the lower left panel. The IOS is in a semi-wraparound configuration to permit optimum viewing and accessibility of the controls and displays.

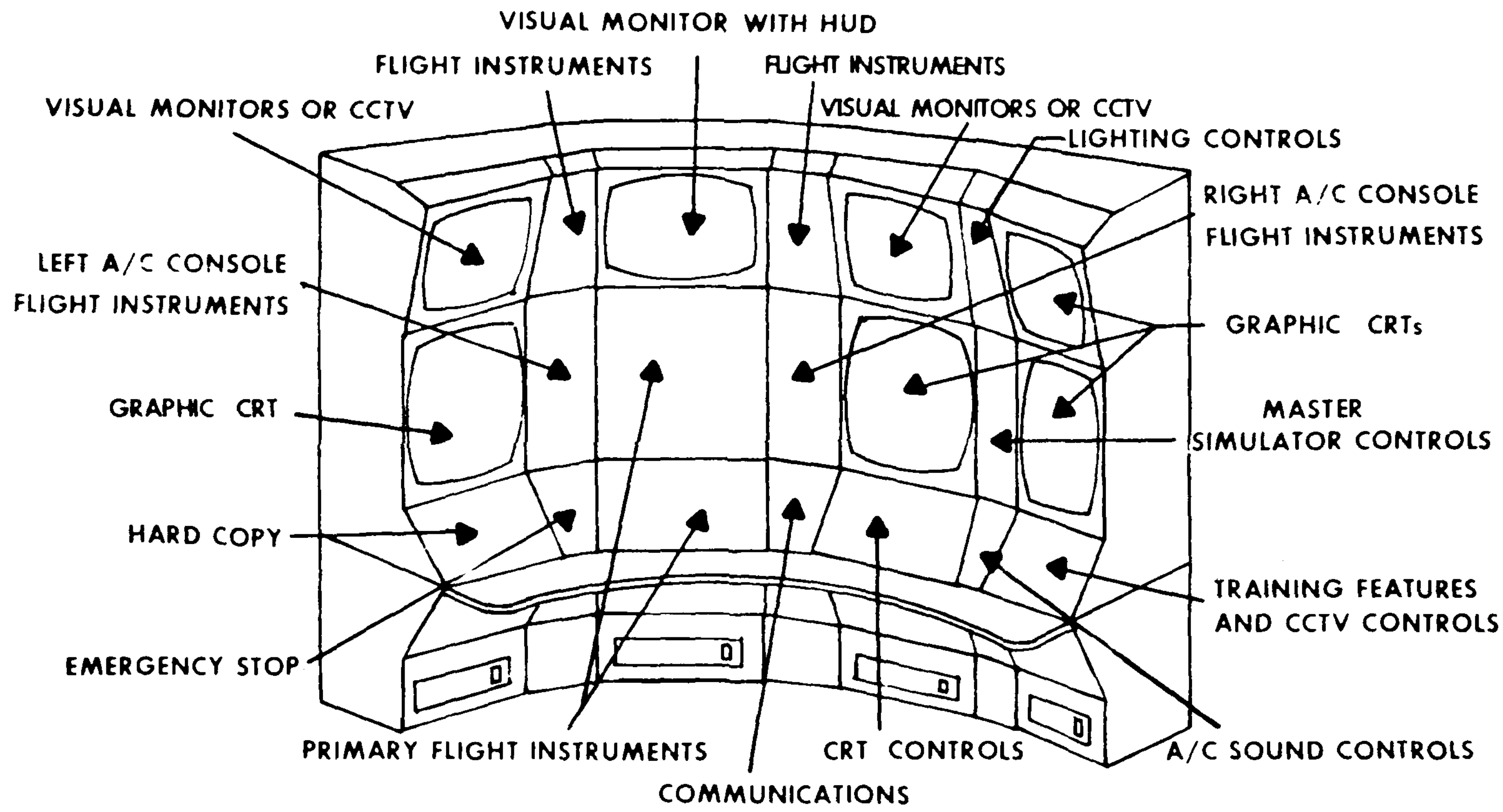


Figure 6. **Proposed A-10 instructor/operator station.**

The IOS design is compatible with a wide-angle cockpit visual system comprised of a multi-CRT display mosaic similar to the ASPT visual system. Any of the CRT channels can be selected by the IP for presentation on the IOS visual monitors. It was assumed that a motion system would not be incorporated in the A-10 simulator. Consequently, motion control functions were not included in the IOS design. Furthermore, no provision was made to provide direct access to the computer software from the IOS in order to preserve the existing capabilities of the simulated system. All program modifications will be accomplished off-line under the auspices of the using command.

The specific controls and displays provided on each panel and the CRT pages utilized in the design are identified in Attachment 2. The panels are enumerated in Figure B-1 (Appendix B) and are individually illustrated in Figures B-2 through B-34. Their function and operation are described in the corresponding tables, i.e., Tables B-1 through B-33.

The components of each panel reflect the control and display requirements for A-10 flight training that were established via the questionnaire and observation of the IPs at the ASPT IOS. Some of the controls and displays included in the IOS panels were not actually used nor recommended by the IPs as requirements for training. For the most part, these were ASPT operator functions that were essential to the conduct of flight training. Since the IP will also serve as the IOS operator in the proposed design, these functions were incorporated in the A-10 IOS panels. Also, some ASPT IOS displays were used that were not integrated into the IOS panels. These displays were included in the ASPT IOS since they are integral to undergraduate pilot training (UPT) in the T-37. Simply stated, the displays were used by the A-10 IPs because they were available. In order to preserve the integrity and fidelity of the A-10 flight instrument panels, these displays were omitted in the proposed A-10 IOS.

In the sketches of the IOS panels provided in Appendix B, the dimensions of each panel and its associated controls and displays were reduced to fit in a single page. In actuality, they are the same size as in the aircraft. The controls and displays that have no predetermined size, such as the CRT control keyboard, would be designed according to the human engineering design criteria contained in MIL-STD-1472 and related documents. These design standards would also be applied to the definition of CRT character size, display labeling and coloring, control forces, and so on.

The IOS design incorporates the capability to conduct all facets of A-10 flight training. The instructional and operational tasks which the IOS can support are categorized as follows:

A. Simulator Operations

1. Application of power to the simulator

2. Control loading system control

3. System initialization

4. Communications

5. System shutdown and emergency stop

B. Monitoring, Evaluating, and Controlling Student Performance

1. Conversion training

a. ground cockpit checks

b. takeoff, climb and level-off

c. normal and closed patterns

d. normal flight maneuvers

e. abnormal flights and spins

f. basic airwork and aerobatics

g. radio and instrument navigation

h. formation flight

i. visual and ground controlled approaches and landings

2. Surface attack training

a. weapons loading

b. target approaches—dive angle and ground path

c. bomb delivery

d. strafe

C. Utilization of IOS Training Features

1. Conventional training features

a. malfunction insertion

b. flight controls monitoring—stick and throttle position

c. hardcopy

d. automated student performance scoring

e. crash override and reset

f. aircraft environmental control

2. Specialized training features

a. video and voice recording and playback

b. initial condition reset

c. position freeze and reset

d. manual aircraft configuration and position setup

e. repeater heads-up display (HUD)

D. IOS Configuration and Environment Control

1. CRT page assignment

2. IOS speakers and aircraft sound control

i. IOS [illegible]

j. [illegible] TV control

k. Visual scene select

The proposed IOS was intentionally designed to simplify the operational requirements while simultaneously providing the maximum A-10 flight training capability. With a limited amount of training, the IP should be able to perform the operator functions as well as the training functions; therefore, the IOS was configured to accommodate one person [illegible] the IP. In the event that the simulator is used only sparingly by [illegible] IPs, it is suggested that a [illegible] grade technician be made available to provide assistance in the operation of the simulator from the IOS.

Conclusions

The [illegible] interactive graphic [illegible] capability provided [illegible] IOS design insures a highly flexible [illegible] environment that [illegible] not be achievable with function-dedicated IOS controls [illegible]. As new training requirements are defined, [illegible] pages can be added, or the existing [illegible] without altering [illegible] IOS hardware configuration. It will be recalled that actual [illegible] were [illegible] in the IOS design [illegible] response to the stated [illegible] this [illegible]. This approach introduces a constraint on the [illegible] of the IOS design [illegible] hardware [illegible] would be required to stay abreast of the changes that [illegible] in the configuration of the actual aircraft crew station. [illegible] CRT presented "pseudo-instruments." Although the IPs expressed dissatisfaction with pseudo-instruments because it was felt that these items lack sufficient [illegible] and resolution [illegible] performance monitoring, CRT technology is advancing [illegible] using pseudo-instruments should be continually evaluated.

[illegible] IOS design, the interactive graphic CRT control capability is provided through a [illegible]. Other control input devices that would have application to [illegible] touch sensitive CRT [illegible] of these control capabilities [illegible] control directly on the CRT page. For example, to reposition the [illegible] at the aircraft symbol and activated and then pointed at the [illegible]. With the touch sensitive display, the [illegible] need only touch the symbol [illegible] to reposition the aircraft. It is suggested that a systematic experiment [illegible] control input capabilities in terms of instructional efficiency [illegible] order to provide [illegible] control system. The CRT control unit in the A-10 IOS design which [illegible] ball was implemented to show the control requirements [illegible] control panel.

[illegible] IOS design [illegible] in this report is based on the requirements established by the [illegible] that this is a preliminary and tentative IOS design solution [illegible] through a human engineering evaluation of the preliminary [illegible] would be accomplished as follows. First, detailed *drawings* of the proposed [illegible] operating instructions would be distributed to a sample of experienced [illegible] asked to critique the design. Another technique would be to [illegible] display layouts and then ask experienced users to rate or rank [illegible]. Second, a *static mockup* would be developed providing a [illegible] the IOS. The IOS [illegible] be made of inexpensive materials such as [illegible]. All major IOS components should be represented by actual [illegible] drawings or photographs. The static mockup can be used [illegible] evaluations [illegible] observational and operational. In the [illegible] is used to estimate the adequacy of various layouts and arrangements by comparing them against the published design criteria. An operational test can be accomplished by having the users simulate the movements they would normally have made in operating the IOS. Any difficulties experienced by the users and the ease with which movements are made would be recorded. Third, a *prototype* IOS would be constructed with operational controls and displays, but not yet integrated into the overall simulation system. The prototype makes it possible to study the performance of the users in simulated operational settings. Thus, the IOS can be evaluated in terms of human performance. From the data collected, the prototype can be modified to provide a functionally optimum, finalized IOS.

V. INSTRUCTIONAL FEATURES EVALUATION

Introduction

State-of-the-art training features are frequently procured in simulation systems without adequate attention by training managers and device designers alike concerning how such capabilities can be used in the training process. Consequently, such training features are often not exploited sufficiently and sometimes the features are not used at all. In the operational flight training environment, for instance, the simulator often becomes scarcely more than a surrogate aircraft, with little concern devoted to how available training features might function to enhance simulation capabilities *beyond* the training value offered by the aircraft itself.

The ASPT incorporates a number of advanced training features. Because many of these training features are not available in conventional simulators and since the ASPT possesses the flexibility of a research device, a testbed is available for systematic exploitation of advanced training features. The training feature capabilities of the ASPT include: problem and parameter freeze, rapid initialization, automatic demonstration, automated performance feedback, self-confrontation, and task difficulty and complexity variation.

Problem and Parameter Freeze: The freeze capability exists on most conventional simulators. The ASPT may be stopped, with all instruments and visual displays frozen in their position, to give the student time to catch up, to let the instructor's briefing remain current with the aircraft, or to let the instructor emphasize a particular point.

Rapid Initialization: The simulated aircraft can be placed at a particular point in space instantaneously and with a given configuration without "flying" it there.

Automatic Demonstration: A selected maneuver or a part thereof can be recorded and stored for demonstration purposes. Playback involves all motion cues, instrument readings, and visual scenes of the total simulator system. Recorded audio instruction synchronized with the visual display can accompany the playback when desired.

Automated Performance Feedback: Students can be provided with feedback on their performance through performance playback, CRT presentation, alphanumeric score, audio message, or any combination of these.

Self-Confrontation: The students can examine their own performance through a playback of that performance using all systems including stick, throttles, and rudder. This playback can be presented in slow, real, or fast time (except motion).

Task Difficulty and Complexity Variation: Any given maneuver can be varied in difficulty and complexity using the motion system, malfunction insertion, and environmental factor capabilities of ASPT. The motion system can be restricted to any combination of six dimensions:

longitudinal, lateral, vertical, roll, pitch, and yaw movements. The malfunction insertion capability enables simulated emergencies to be inserted in the mission, either directly by the instructor, or automatically, when a predetermined set of conditions exist. Environmental factors such as wind direction, wind velocity, and turbulence can be used for training and for increasing the task loading.

Research Objective

The objective of the present study was to evaluate the utilization of the ASPT training features in the context of A-10 conversion and surface attack training. The study represents an initial effort directed toward determining the training features required for full mission A-10 simulation. Because the present study is descriptive rather than experimental and represents a preliminary effort, its scope is somewhat limited in terms of both generalizability of results and rigorous evaluation methods. However, the data presented should serve as a baseline for contrasting with follow-on research and development efforts aimed at increasing the effective implementation of training features in simulators.

Study Approach

The study approach was observational and descriptive rather than experimental.

Subjects: Ten TAC A-10 IPs were engaged across three classes of A-10 conversion and surface attack training.

Equipment: The ASPT was used.

Independent Variables: The study was descriptive; consequently, there were no independent variables per se.

Dependent Variables: Data sources included standardized questionnaires and structured observations of instructor behaviors during the ASPT training sessions.

Procedures: Data collection involved two independent schemes: standardized questionnaires and structured observation techniques. The questionnaire format required the IP to use a 4-point scale and rate the utility of each training feature for training students to perform each maneuver/task in the conversion training syllabus. In addition, the questionnaire required the IPs to specify, in open-ended fashion, any anticipated problems in using the instructional features with the students. Finally, an open-ended question required the IPs to list any additional instructional features that they would like to see incorporated into the A-10 simulation facility.

Prior to administering the questionnaire, the IPs as a group, received a detailed briefing, involving a description of each feature, how it is implemented on the ASPT, and some exemplary uses of each feature. The purpose of the study was described, and the questionnaire was discussed thoroughly. Subsequently, each IP was given a copy of the questionnaire and requested to complete it when convenient. Concurrent with the questionnaire, a systematic observation procedure was implemented to determine the frequency with which each training feature was implemented. This procedure was in effect during all of the conversion and surface attack training phases. The observer was seated at the ASPT IOS and noted the IPs' instructional behaviors in an unobtrusive manner.

Results

The results of the evaluation are presented and discussed in terms of three different data sources: (a) instructors' ratings on the utility of each feature in training each maneuver/task in the conversion and surface attack training syllabus, (b) instructors' utilization of the features during conversion and surface attack training, and (c) anecdotal responses from instructors and students regarding anticipated problems in implementing each of the training features and suggested additional training features they would like to see incorporated into a full mission A-10 simulation system.

1. *Instructor Ratings:* Table 20 shows the mean IP ratings for each of the training features by conversion training task. As shown on the table, the performance feedback ranged from 2.0 (would sometimes use feature) to 3.75 (4.0 indicating that the feature would always be used). The remaining features tended to cluster around 2.25 (occasional use of feature), with no particular discernible pattern regarding tasks for which specific instructional features are judged more appropriate. Due to the limited sample size, inferential statistics are not appropriate in drawing conclusions regarding differential preferences for the remaining features. However, it seems safe to conclude that performance feedback is a high priority in considering future developmental efforts aimed at incorporating advanced training features into ongoing A-10 syllabuses. It is not clear from the present data which type of feedback would be preferred. Observational data will be described subsequently which suggest the forms of feedback most frequently used by A-10 instructors.

Table 21 shows the mean IP ratings for each training feature by surface attack training task. Again, the ratings indicate that performance feedback is by far the highest priority training feature, with the maximum rating obtainable (4.0, would always use) being given for all surface attack tasks except for the hung bomb pattern. Follow-up questioning did not indicate why a substantially lower rating should be given to this particular pattern. The second highest rating was for initialization. The apparent interest in the initialization feature concerns the availability of a range of predetermined initialization points whereby the IP can have a number of options to select from, cafeteria-style.

Figure 7 provides a basis for an overall comparison regarding the importance of each feature between conversion and surface attack training phases. It is clear from an inspection of Figure 6 that the features tended to maintain their order of preference across both phases of training. Also, both performance feedback and initialization tended to be rated substantially higher for surface attack training than for conversion training.

2. *Training Feature Utilization:* Figure 8 shows the relative frequency with which each training feature was used within the conversion and surface attack training phases. Performance feedback was used relatively frequently in both phases, although this feature was not provided for in the system software. In this instance, performance feedback refers to verbalizations provided by the instructor *after* the student's performance. Such verbalizations, for the sake of convenience, were categorized into three levels according to content: knowledge of results, knowledge of the correct response, and instructional feedback. Knowledge of results informs the student whether the performance met criterion, knowledge of the correct response indicates whether the response met criterion *and* informs the student what the appropriate response is, while instructional feedback provides both types of information in addition to informing the student what was wrong with the performance and how to correct it. Obviously, instructor-provided feedback, categorized in this manner, is hierarchical in accordance with the amount of information provided by the instructor.

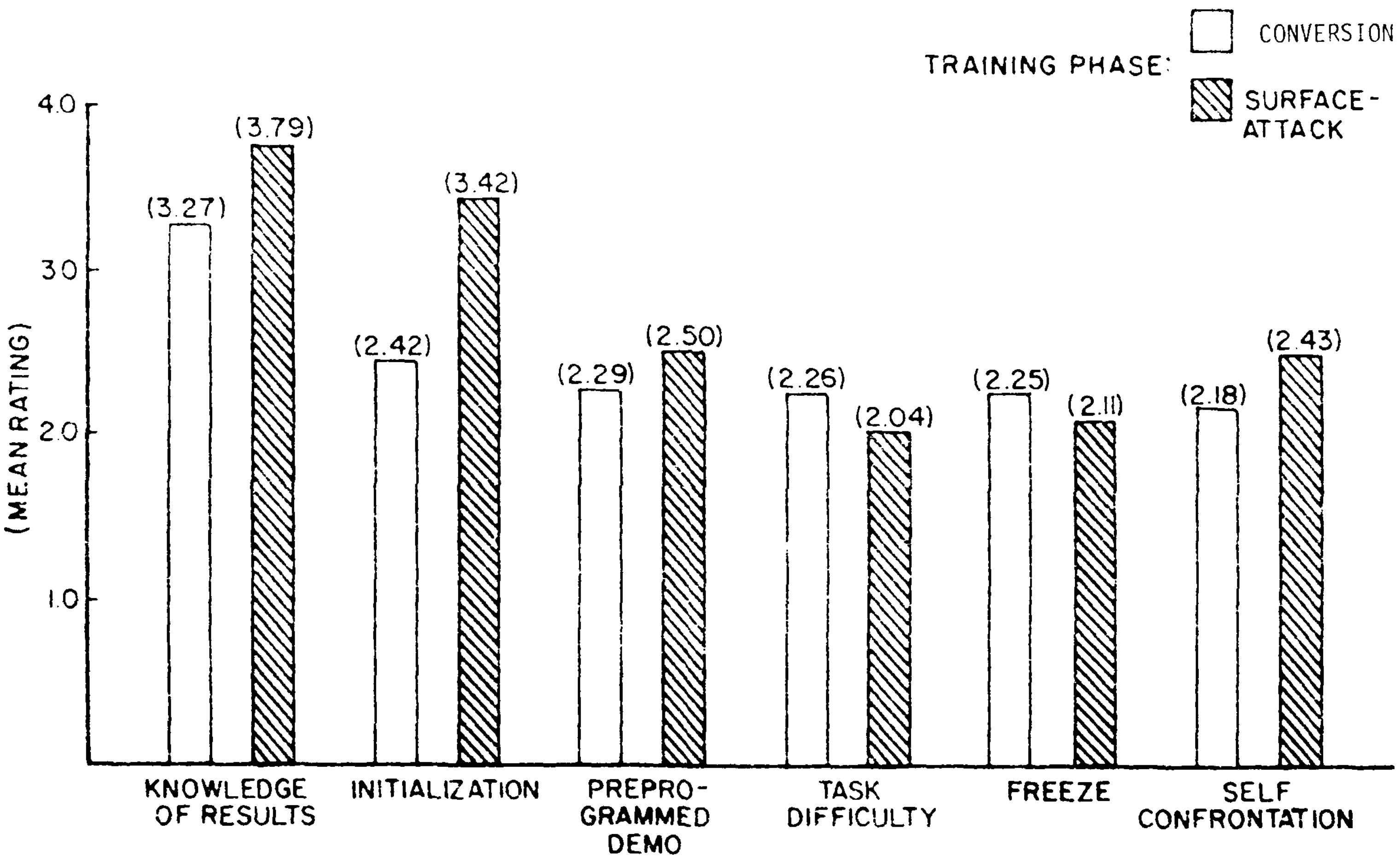
Figure 9 shows the relative frequency with which each type of manually-provided performance feedback was utilized across the conversion and surface attack training phases of training. It is clear that instructional feedback was utilized substantially more frequently than were the other two types of feedback. Although these particular data do little to indicate the value of currently available performance feedback options, they do indicate a definite instructor preference for more elaborate forms of feedback. *This fact, taken in conjunction with the strong preference for performance* feedback as a priority training feature, suggests that emphasis be placed on developing automated

Table 20. **Mean IP Ratings for Each Training Feature by Conversion Training Task**

Conversion Training Task	Freeze	Initialization	Automatic Demonstration	Knowledge of Results	Self-Confrontation	Task Difficulty and Complexity	Overall
Takeoff, climb, level off	2.50	4.00	1.75	3.25	2.25	2.50	2.71
Practice stalls	1.75	2.50	1.75	2.00	1.50	1.25	1.79
Lazy 8, Aileron Roll (speed brakes out)							
Aileron Roll (speed brakes closed)	1.50	2.25	2.00	2.25	1.50	1.25	1.79
Loop, Cuban 8, Split S	1.75	2.50	1.75	2.00	1.50	1.25	1.79
Descent, straight-in, low approach	1.75	2.50	2.00	3.25	2.00	2.25	2.29
Re-entry, normal overhead, low approach	2.50	2.25	2.75	3.75	2.25	2.75	2.71
Re-entry, normal overhead, touch and go	2.25	2.25	2.50	3.75	2.25	2.75	2.63
Closed traffic, normal overhead, touch and go	2.75	2.50	2.75	3.75	2.75	2.75	2.88
Re-entry, normal overhead, full stop	2.50	2.25	2.25	3.75	2.25	2.00	2.50
Single engine maneuvering and go-around	2.00	2.50	1.25	2.25	2.00	1.50	1.92
Descent, SFO, low approach	2.75	3.00	2.50	3.25	2.25	2.00	2.63
Re-entry, SFO, touch and go	2.75	2.25	2.75	3.25	2.50	2.00	2.58
Re-entry, straight-in approach, go-around	2.00	2.25	2.00	3.00	1.75	2.25	2.21
Re-entry, no-flap overhead, touch and go	2.25	2.25	3.00	3.50	2.25	2.75	2.67
Closed, no-flap overhead, touch and go	2.50	2.50	2.75	3.50	2.75	2.75	2.79
Re-entry, single engine overhead, low approach	2.25	2.25	2.50	3.50	2.75	2.50	2.75
Closed, single engine overhead, touch and go	2.50	2.50	2.75	3.50	2.75	2.50	2.75
Descent, SFO, touch and go	2.25	2.25	2.25	3.50	2.00	2.00	2.38
Re-entry, normal overhead, touch and go	2.25	2.25	2.50	3.75	2.25	2.75	2.63
Closed, minimum runlanding, full stop	2.25	2.50	2.25	3.25	2.50	2.50	2.54
Straight-in approach, normal overhead, low approach	2.00	2.25	2.00	3.50	2.00	2.75	2.42
Re-entry, SFO, low approach	2.25	2.25	2.50	3.50	2.25	2.00	2.45
Closed, normal overhead, low approach	2.50	2.25	2.25	3.75	2.25	2.75	2.63
Closed, no-flap overhead, low approach	2.25	2.25	2.25	3.50	2.25	2.75	2.54
Closed, single engine, single engine go-around	2.25	2.00	2.25	3.50	2.25	2.00	2.38
Overall	2.25	2.42	2.29	3.27	2.18	2.26	

Table 21. Mean IP Ratings for Each Training Feature by Surface Attack Training Task

Conversion Training Task	Freeze	Initialization	Automatic Demonstration	Knowledge of Results	Self-Confrontation	Task Difficulty and Complexity	Overall
Dive Bomb	2.25	3.00	2.75	4.00	2.75	2.00	2.79
Low Angle Low Drag	2.25	3.00	2.75	4.00	2.75	2.00	2.79
Low Angle Bomb	2.25	3.00	2.75	4.00	2.75	2.00	2.79
Low Angle Strafe	2.25	3.00	2.75	4.00	2.75	2.00	2.79
Rocket Delivery	2.25	3.00	2.75	4.00	2.50	2.00	2.75
Hung Bomb Pattern	1.25	3.25	1.00	2.50	1.25	2.25	1.92
Overall	2.11	3.04	2.50	3.79	2.43	2.04	



The following 4-point scale was used: 1 = IP would *never* use this feature; 2 = IP would *sometimes* use this feature; 3 = IP would *frequently* use this feature; 4 = IP would *always* use this feature.

Figure 7. **Comparison of mean IP ratings across conversion and surface-attack training phases.**

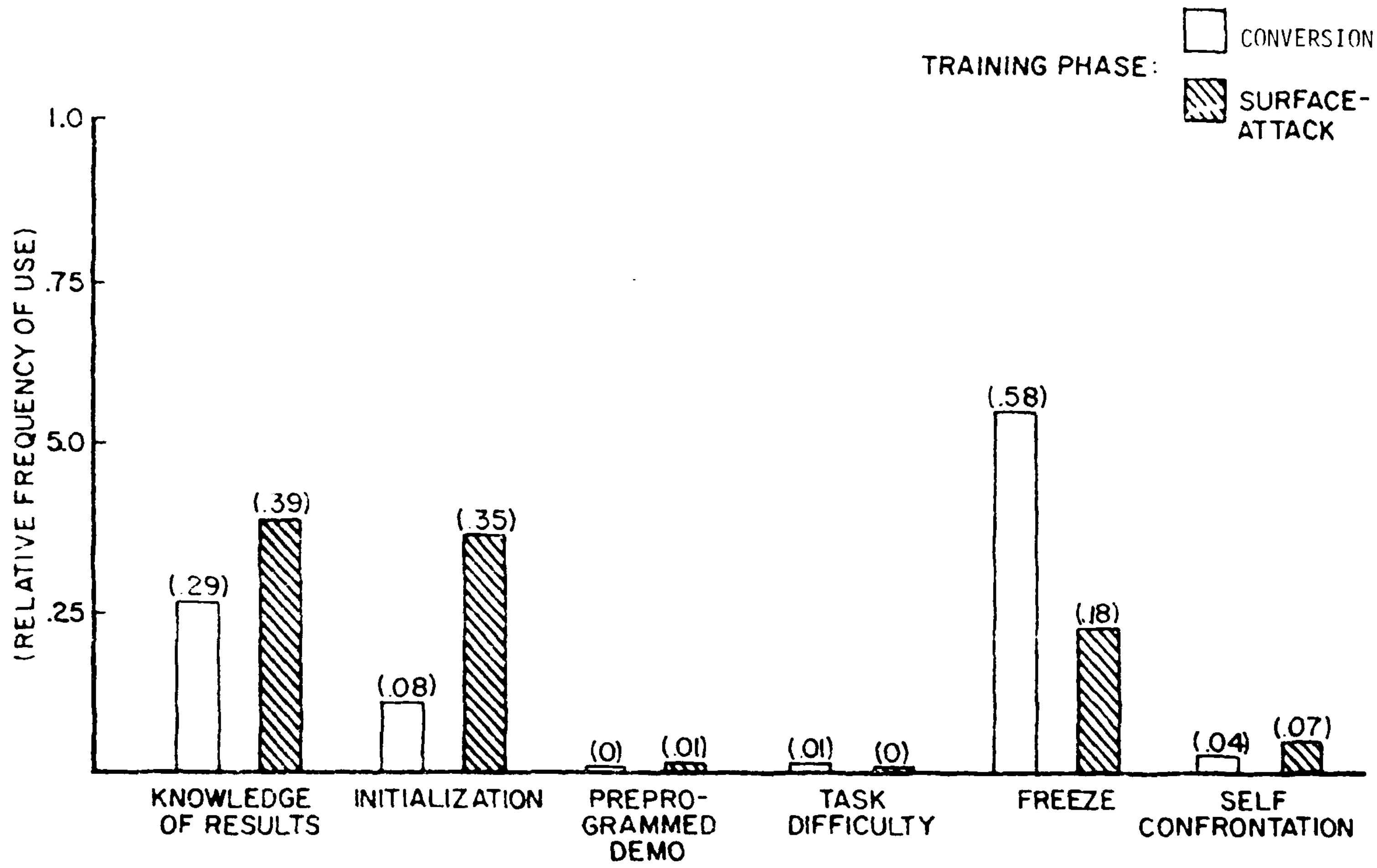


Figure 8. Relative frequency of use for each training feature across conversion and surface attack training phases.

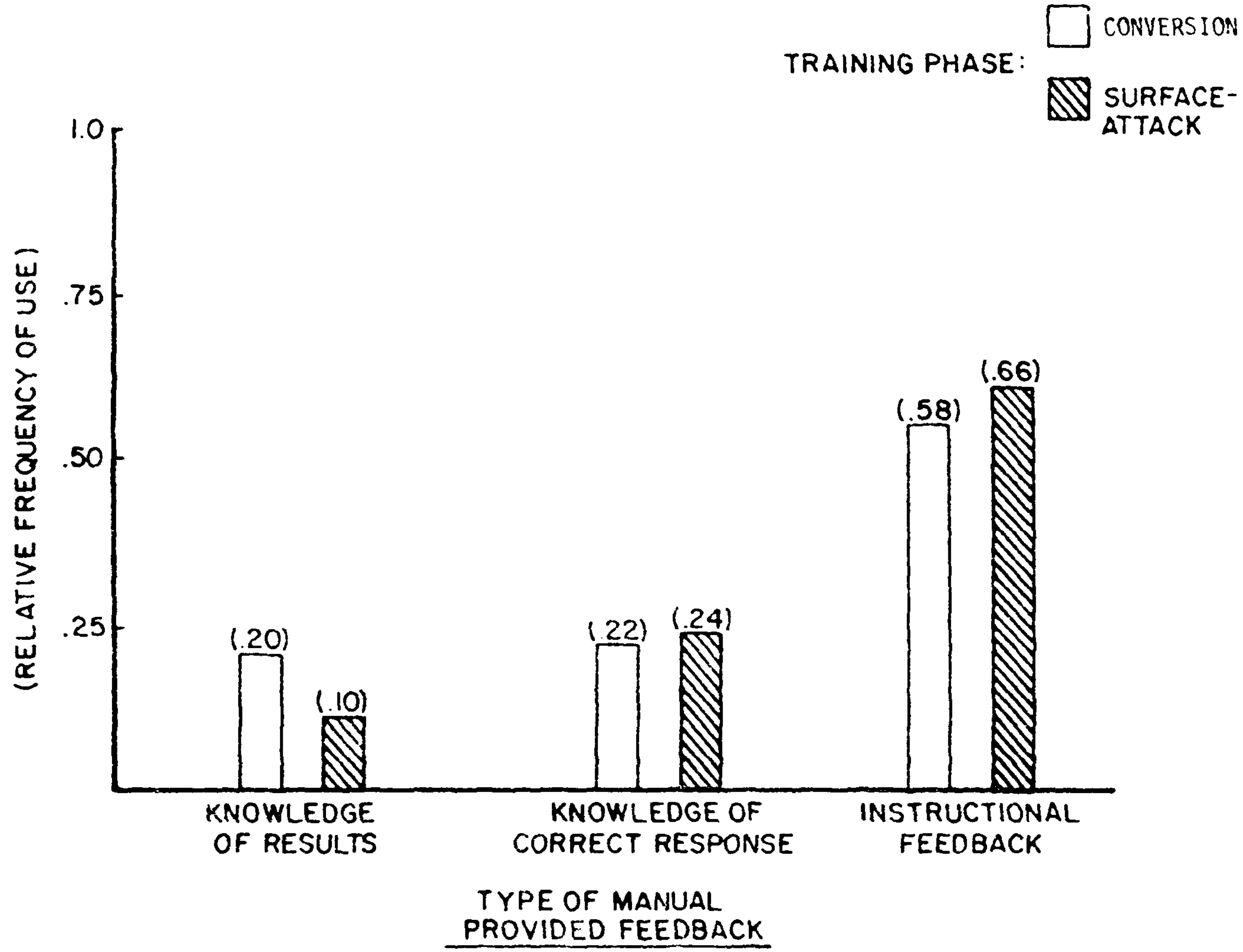


Figure 9. Relative frequency of use for each type of manually provided feedback across conversion and surface attack training phases.

feedback capabilities. Such capabilities would provide individualized instruction that is characteristically more accurate and reliable than that which most skilled instructors can provide.

3. *Anecdotal Instructor Comments:* Open-ended questions were included with training feature task ratings in order to furnish more detailed information about instructor perceptions of the training fea ures. Section II of the questionnaire examined anticipated problems with the current training features. Section III dealt with suggested additional training features. Comments for all respondents have been summarized and are presented as follows:

Question 1. Specify any problems you might anticipate in using the following instructional features with your students:

1. Freeze: Instructors indicated a concern that the freeze feature, when used in an instructional mode, can create too many interruptions in the task. They pointed out the importance of maintaining continuity in the maneuver particularly in terms of full mission simulation. In addition to the disruptive potential of the freeze feature, a number of instructors indicated a problem with the apparent delay that occurs between the instructor initiation of the freeze feature and when the system actually "stops" action. This delay is particularly critical when freeze is used to provide feedback after an error occurs because such feedback is most effective when arranged immediately contingent on student performance.

2. Initialization: The primary concern voiced by IPs with respect to the initialization feature involved providing enough predetermined initialization points and combinations thereof to satisfy a large number of maneuvers. This concern would be particularly appropriate when the initialization feature is used in conjunction with freeze in reinstating the student to an appropriate state following erros and consequent remediation.

3. Performance Feedback and Self-Confrontation: Due both to the similarity of these two features and to the similarity of comments among instructors, these features will be treated together here. All instructors indicated these were "super" features but problems could arise in engendering frustration in the student if not used in a positive manner. In addition, the instructors agreed that both of these features could be time-consuming and cut down on the amount of stick time the student receives if not used appropriately.

4. Automatic Demonstration: The only concern voiced with respect to the automatic demo feature was that the amount of time required to implement the feature required an equivalent reduction in the student's stick time. All instructors agreed, however, that this was an extremely valuable feature if used judiciously as an option rather than being rigidly adhered to in all instances. In other words, the instructors wish to maintain the option of using their own judgment of whether the student requires a demonstration rather than making it mandatory for all students.

5. Task Difficulty and Complexity: The instructors tended to view this class of features as not being very useful (except for winds) in bombing tasks. Another concern was that this feature could make the task inappropriately complex and interfere with the acquisition of the basic skills. This concern was tempered by the need to have accurate information concerning such environmental factors and their effect on ordnance ballistics.

Implications

The purpose of this study was to evaluate the current use of ASPT's advanced training features in providing full mission A-10 simulation capabilities. However, several limitations of the evaluation were noted prior to initiating the study. The primary limitation, simply stated, is that the training features are not currently being utilized to their full potential. Many of the features, such as automated performance feedback, task difficulty, preprogrammed demonstration, and self-confrontation were scarcely used at all. Some of the features, such as freeze and initialization, were not used in an instructional manner but more for task management purposes. That is, freeze and initialization tended to be used to terminate an exercise and provide a definitive transition to the next exercise, rather than for providing opportunities to give the student performance feedback and appropriate remediation.

The task/instructional enhancement distinction has important implications for follow-on research and development efforts related to realizing the full potential of ASPT's advanced training features. Certainly, it is not appropriate to conduct further evaluation efforts (either formative or summative) until the necessary basic training research has been conducted to determine effective utilization of the features, both individually and in combination. Instructional use of a particular feature or combination of features implies that a functional relationship can be demonstrated between use of the feature(s) and student performance enhancement. The mere availability of a training feature, as we have seen, does not necessarily imply that the feature will be used instructionally.

Although a considerable amount of research is required to determine effective training feature utilization, a data base available in the literature on learning and instruction, as well as previous training research, will provide some good starting points. Knowledge of results, for example, has been repeatedly demonstrated to be effective in enhancing learner performance feedback by the instructors in the current study, indicating that priority should be placed on developing automated feedback capabilities and utilization strategies. The development and use of graphic displays for immediate knowledge of results and in-flight cueing represent needed research areas.

The automatic demonstration and its companion, the self-confrontation feature, would also seem to provide enormous training potential. However, one limitation noted by instructors regarding the use of these features concerns the amount of time required for implementation. Use of these features reduces the amount of "stick time" available during a particular training session since the student cannot watch a demonstration of a maneuver and "fly" the maneuver simultaneously. Consequently, a critical dependent variable for evaluating the efficiency of these, as well as any training features, is the tradeoff between instructional time and practice (stick) time. That is, we need to determine how much student performance increment is gained per unit of instructional time provided.

Another area that requires developmental effort is that of instructor training in the utilization of training features. The potential for using such features to "bridge the gap" between traditional in-flight models of flying training and those relying heavily upon simulation has been described by Hughes (1979) and by Bailey and Hughes (1980). While results caution against making sweeping generalizations as to the effectiveness of specific features (see Hughes, Hannan, & Jones, 1979), applications involving methods such as "backward chaining" (Bailey & Hughes, 1980) suggest that significant training benefits might be obtained.

Such development efforts would be appropriate only after a data base is attained on training feature utilization. However, these research and utilization strategies will be of little use without accompanying implementation plans. During the initial briefing on the available ASPT training features, for example, many of the instructors were unaware of the preprogrammed demonstration capability. After the instructors learned about the capability, they were quite impressed with its potential and subsequently requested that demonstrations of selected surface attack maneuvers be prepared for future A-10 students.

Conclusion

Substantial research and development efforts are required in order to realize the full potential of state-of-the-art simulator training features. Not only is work required in determining optimal utilization procedures for training features individually and in combination, but effort also needs to be focused on developing strategies for implementing advanced training features into ongoing simulation programs, such as A-10 conversion and surface attack training using the ASPT.

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APPENDIX A: TAC A-10 SYLLABUS: APRIL 1978

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DEPARTMENT OF THE AIR FORCE
Headquarters Tactical Air Command
Langley Air Force Base, Virginia 23665

TAC SYLLABUS
Course Nr A1000B/C/TXA/TXB

OPERATIONAL/CONVERSION TRAINING COURSE

A-10

APRIL 1978

INTRODUCTION

This syllabus reflects the general nature of the training required to enable graduates to achieve the standards of proficiency established in this course. It prescribes the overall plan of instruction and the approximate time required for the average student to attain the required proficiency in individual subjects. The level of instruction and time devoted to the individual elements, events, subjects, or phases should be adjusted, as required, to meet the needs of the individual students.

Instructions governing publication and revision of TAC syllabi are contained in TACR 8-1.

ROBERT J. DIXON, General, USAF
Commander

OFFICIAL

FREDERICK A. CROW, Colonel, USAF
Director of Administration

Supersedes TAC Syllabus, Course A1000B A1000C, June 19[illegible]; A1000TXA, July 1977
OPR: TAC/DOOS
OPDR: [illegible] 4444 [illegible]
DISTRIBUTION: X

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TABLE OF CONTENTS

DISTRIBUTION:

TOTAL CYS	NR CYS	BASES/ORGANIZATIONS
3		BERGSTROM AFB
	2	12AF/DO
	1	12AF/CSH
1		CANNON AFB
	1	OLAE 4444 OS(OTD)/F-111D
261		DAVIS-MONTHAN AFB
	10	355TFW/DO
	50	355TTS
	50	333TFTS
	50	358TFTS
	1	OLAC 4444 OS (OTD)/A-7
	100	OLAC 4444 OS (OTD)/A-10
1		HOLLOMAN AFB
	1	479TFTS/DO
26		LANGLEY AFB
	1	TAC/ACMC
	1	TAC/IGIO
	1	TAC/INXU
	15	TAC/DOOT
	1	TAC/DOVF
	5	TAC/DOOS
	1	TAC/SPMM
	1	TAC/XPSY
5		LUKE AFB
	1	4444 OS (OTD)/CC
	1	4444 OS (OTD)/F-4
	1	4444 OS (OTD)/F-15
	1	4444 OS (OTD)/F-16
	1	4444 OS (OTD)/TACS
1		MT HOME AFB
	1	OLAF 4444 OS (OTD)/F-111F
5		MYRTLE BEACH AFB
	5	354TFW/DO
3		NELLIS AFB
	1	USAFTFWC/TA
	1	57FWW/DO
	1	OLAC 4444 OS (OTD)/FWS
3		SHAW AFB
	2	9AF/DO
	1	OLAA 4444 OS (OTD)/RF-4
1	1	ATC/DOTF
1	1	AU/LD
3		CINCUSAFE
	1	CINCUSAFE/DOOF
	1	CINCUSAFE/DOOT
	1	CINCUSAFE/DOST
1	1	NGB/XOF
5		HQ USAF
	1	USAF/ACBIA
	1	USAF/ACMCA
	1	USAF/PRMRM
	1	USAF/XOOVB
	1	USAF/XOOSL

SECTION A

COURSE ACCOUNTING

1. Course Titles/Course Numbers

a. USAF Operational Training Course, A10A/A1000B.

b. USAF First Assignment IP Training Course, A10A/A1000C.

c. USAF Conversion Training Course, A10A/A1000TXA.

d. USAF Transition Training Course, A10A/A1000TXB.

2. Prerequisites/Status Upon Graduation

a. Course A1000B is designed to train UPT graduates with T-38 lead-in training to mission ready status.

b. Course A1000C is designed to train ATC First Assignment IPs (FAIPs) with T-38 lead-in training to mission ready status.

c. Course A1000TXA is designed to train experienced TAC fighter pilots (300 FP/IP hours in tactical fighter/attack aircraft and mission ready/capable in tactical fighter/attack aircraft within the previous three years) toward mission ready status.

d. Course A1000TXB is designed to train experienced TAC fighter pilots to mission support status. Graduates are qualified to enter mission qualification training as outlined in MCM 51-50, Vol II.

3. Location 355TFW, Davis-Monthan AFB, Arizona.

4. Duration

B -- (8 GTD + 52 FTD + 11 ASPT*)	71
C -- (6 GTD + 48 FTD + 3 ASPT*)	57
TXA -- (6 GTD + 25 FTD + 2 ASPT*)	33
TXB -- (6 GTD + 12 FTD)	18

*Advanced Simulator for Pilot Training Research Program.

FLYING TRAINING INVENTORY							
A1000B				A1000C			
SORTIE	STUDENT HOURS	SUPPORT SORTIES	SUPPORT HOURS	SORTIE	STUDENT HOURS	SUPPORT SORTIES	SUPPORT HOURS
CV-1/B	2.0	1	2.0	CV-1/T	2.0	1	2.0
CV-2/B	2.0	1	2.0	CV-2/T	2.0	1	2.0
CV-3/B	2.0	1	2.0	CV-3/T	2.0	1	2.0
CV-4/B	2.0	1	2.0	CV-5/B	2.0	1	2.0
CV-5/B	2.0	1	2.0	(P) CV-6/B	2.0	1	2.0
(P) CV-6/B	2.0	1	2.0	IQ	2.0	1	2.0
IQ	2.0	1	2.0				
TOTAL CV-7	14.0	7	14.0	TOTAL CV-6	12.0	6	12.0
BAM-1	2.0	1	2.0	BAM-1	2.0	1	2.0
BAM-2	2.0	1	2.0	BAM-2	2.0	1	2.0
(P) BAM-3	2.0	1	2.0	(P) BAM-3	2.0	1	2.0
TOTAL BAM-3	6.0	3	6.0	TOTAL BAM-3	6.0	3	6.0
SA-1	1.8	1	1.8	SA-1	1.8	1	1.8
SA-2	1.8	1	1.8	SA-2	1.8	1	1.8
SAAR-3	2.7	.33	.9	SAAR-3	2.7	.33	.9
(P) SA-4	1.8	.33	.6	(P) SA-4	1.8	.33	.6
(P) SA-5	1.8	.33	.6	(P) SA-5	1.8	.33	.6
SA-6	1.8	1	1.8	SA-6	1.8	1	1.8
SA-7	1.8	1	1.8	SA-7	1.8	1	1.8
SAAR-8	2.7	.33	.9	SAAR-8	2.7	.33	.9
(P) SA-9	1.8	.33	.6	(P) SA-9	1.8	.33	.6
SA-10	1.8	.33	.6	SA-10	1.8	.33	.6
TOTAL SA-10	19.8	6.00	11.4	TOTAL SA-10	19.8	6.00	11.4
SAT-1	1.8	.5	.9				
SAT-2	1.8	.5	.9	SAT-2	1.8	.5	.9
SAT-3	1.8	1	1.8	SAT-3	1.8	1	1.8
SAT-4	1.8	.5	.9	SAT-4	1.8	.5	.9
SAT-5	1.8	.5	.9	(P) SAT-5	1.8	.5	.9
(P) SAT-6	1.8	.5	.9				
SAT-7	1.8	1	1.8	SAT-7	1.8	.5	.9
SAT-8	1.8	1	1.8	(P) SAT-8	1.8	1	1.8
SAT-9	1.8	1	1.8	SAT-9	1.8	1	1.8
SAT-10	1.8	1	1.8	SAT-10	1.8	1	1.8
SAT-11	1.8	1	1.8	SAT-11	1.8	1	1.8
TOTAL SAT-11	19.8	8.5	15.3	TOTAL SAT-9	16.2	7.0	12.6
NCV	1.5	1	1.5	NCV	1.5	1	1.5
NSAAR	2.7	.33	.9	NSAAR	2.7	.33	.9
TOTAL Night 2	4.2	1.33	2.4	TOTAL Night 2	4.2	1.33	2.4
DCM	1.8	1	1.8	DCM	1.8	1	1.8
DDCM	1.8	1	1.8	DDCM	1.8	1	1.8
DACT	1.8	1	1.8	DACT	1.8	1	1.8
DACT/SAT	1.8	1	1.8	DACT/SAT	1.8	1	1.8
TOTAL DACT 4	7.2	4	7.2	TOTAL DACT 4	7.2	4	7.2
TOTAL 37	71	29.8	56.3	TOTAL 34	65.4	27.3	51.6
(PROF ADV) (31)	(59.8)	(16.3)	(49.6)	(27)	(52.4)	(22.8)	(43.1)

FLYING TRAINING INVENTORY

A1000TXA

SORTIE	STUDENT HOURS	SUPPORT SORTIES	SUPPORT HOURS
CV-1/T	2.0	1	2.0
CV-2/T	2.0	1	2.0
CV-3/T	2.0	1	2.0
CV-4/T	2.0	1	2.0
(P) CV-5/T	2.0	1	2.0
IQ	2.0	1	2.0
TOTAL CV-6	12.0	6	12.0
SA-1	1.8	1	1.8
SA-2	1.8	1	1.8
SAAR-3	2.7	.33	.9
(P) SA-4	1.8	.33	.6
SA-7	1.8	1	1.8
SA-10	1.8	.33	.6
TOTAL SA-6	11.7	4.00	7.5
SAT-4	1.8	.5	.9
SAT-5	1.8	.5	.9
SAT-7	1.8	1	1.8
SAT-10	1.8	1	1.8
TOTAL SAT-4	7.2	3.0	5.4
NCV	1.5	1	1.5
NSAAR	2.7	.33	.9
TOTAL Night 2	4.2	1.33	2.4
TOTAL 18	35.1	14.33	27.3
(PROF ADV) (16)	(31.3)	(13)	(24.7)

A1000TXB

SORTIE	STUDENT HOURS	SUPPORT SORTIES	SUPPORT HOURS
CV-1/T	2.0	1	2.0
CV-2/T	2.0	1	2.0
CV-3/T	2.0	1	2.0
CV-4/T	2.0	1	2.0
(P) CV-5/T	2.0	1	2.0
IQ	2.0	1	2.0
NCV	1.5	1	1.5
TOTAL CV-7	13.5	7	13.5
(PROF ADV) (6)	(11.5)	(6)	(11.5)

GROUND TRAINING INVENTORY (HOURS)

	B	C	TXA	TXB
ACADEMIC				
Specialized Training (ST)	17.5	17.5	13.5	9.5
Aircraft General (AG)	21.5	21.5	21.5	21.5
Instruments (I)	9.0	9.0	9.0	9.0
Weapons Delivery (WD)	14.0	14.0	9.0	-
Conventional Weapons (CW)	7.0	7.0	7.0	-
Tactics (TAC)	33.0	33.0	27.0	-
Intelligence (IN)	6.0	6.0	-	-
Basic Fighter Maneuvers (BFM)	2.0	2.0	-	-
PART TASK TRAINER				
Advanced Simulator for Pilot Training (ASPT)	10.0	-	-	-
Cockpit Procedures Trainer (CPT)	7.5	7.5	7.0	5.5
Egress Procedures Trainer (EPT)	2.0	2.0	1.5	1.0
Aircraft (AC)	5.0	5.0	3.0	3.0
	134.5	124.5	98.5	49.5

A1000B/C/TXA

WEAPON TRAINING INVENTORY (PER AIRCRAFT)

SORTIE	COURSE	30MM	BDU 33	MK 106	2.75 RX	MK-82HD (INERT)	MK-82HD (LIVE)	A/A 37A-T1	MK-24 FLARES	RANGE UTILIZATION TYPE/PASSES/HOURS
SA-1	B/C/T	108	12							Manned/25/.8
SA-2	B/C/T	108	6	6	4					Manned/28/.8
SAAR-3	B/C/T	216	6	6						Manned/25/.8
SA-4	B/C/T	108	6	6						Manned/20/.8
SA-5	B/C	108	6	6						Manned/22/.8
SA-6	B/C	108	6	6						Manned/25/.8
SA-7	B/C/T	216	6	6						Manned/30/.8
SAAR-8	B/C	216	6	6						Manned/25/.8
SA-9	B/C	216	6	6						Manned/25/.8
SA-10	B/C/T	216	6	6						Manned/25/.3
SAT-1	B	108	6	6				1		Unmanned/15/.5
SAT-2	B/C	108	6	6				1		Unmanned/15/.5
SAT-3	B/C	108	6	6				1		Unmanned/19/.5
SAT-4	B/C/T	108	6	6				1		Unmanned/15/.5
SAT-5	B/C/T	108	6	6	4			1		Unmanned/19/.5
SAT-6	B	108	6	6				1		Unmanned/15/.5
SAT-7	B/C/T	108	6	6	4			1		Unmanned/19/.5
SAT-8	B/C	108		12	4			1		Unmanned/19/.5
SAT-9	B/C	500				10				Unmanned/20/.5
SAT-10	B/C/T	1000						1		Unmanned/20/.5
SAT-11	B/C	215			8		4			Unmanned/20/.5
NSAAR	B/C/T	108	6						8	Manned/20/.5
DACT/SAT	B/C					4		1		Unmanned/10/.3
TOTALS	B	4307	114	108	24	14	4	10	8	
	C	4091	102	96	24	14	4	8	8	
	TXA	2404	66	48	12	0	0	4	8	

SECTION B

COURSE MANAGEMENT

TRAINING OBJECTIVES AND GRADING SYSTEM*

1. GENERAL: The goal of these formal courses is to provide the graduate with flying skills and prerequisite knowledge that will enable him to be certified Mission Ready (MR) by his gaining unit in minimum time. Mission Ready certification requires successful accomplishment of various written examinations and a mission qualification flight evaluation.

2. COURSE OBJECTIVES: The course objectives reflect the training prescribed in TACM 51-50, Vols I and II. The Course Objectives Charts are provided in Attachment 1 and denote student progression/performance levels in terms of sortie milestones. The Course Standard (CRS STD) column reflects the minimum required end-of-course performance levels.

3. PERFORMANCE LEVELS: Depending on the objective performance prescribed by the Course Objectives Charts, there are three levels of acceptable performance possible: 3, 2, and 1.

LEVEL	DESCRIPTION OF PERFORMANCE
3	Performs correctly, efficiently, skillfully, and without hesitation. This is the desired student performance for all course objectives.
2	Performs in an essentially correct manner. Recognizes and corrects errors. This is the minimum required performance level for progression or graduation for all course objectives except those that are designated 1 in the Course Objectives Charts.
1	Performs safely but has limited proficiency. Makes errors of commission or omission. This is satisfactory performance only for: (1) Those objectives with a Course Standard (CRS STD) of 1; (2) Other course objectives on sorties prior to 2 or 3 desired performance levels as denoted by the Course Objectives Charts.

4. GRADING SYSTEM*: The following grading symbols and terms are designed to relate directly to the course objectives performance levels.

GRADES FOR INDIVIDUAL OBJECTIVES

GRADE	EXPLANATION
UNKNOWN	Performance not observed or the element was not performed.
DANGEROUS	Performance was unsafe.
0	See A-10 B/C/TXA/TXB Training Objectives Pamphlet for grading criteria definition.
1	Performs safely but has limited proficiency. Makes errors of commission or omission. This is satisfactory proficiency only for: (1) Those objectives with a Course Standard (CRS STD) of 1; (2) Other course objectives on sorties prior to 2 or 3 desired performance levels as denoted by the Course Objectives Charts.
2	See A-10 B/C/TXA/TXB Training Objectives Pamphlet for grading criteria definition.
3	See A-10 B/C/TXA/TXB Training Objectives Pamphlet for grading criteria definition.

*This test grading system is to be used until the new TACR 50-31 grading system is implemented.

GRADE FOR OVERALL SORTIE PERFORMANCE

GRADE	EXPLANATION
0	Unsatisfactory performance -- Progress behind syllabus flow (received one or more grades of 0 or D for individual objectives). Recommended additional training requires an X sortie.
1	Marginal performance -- Progress behind syllabus flow (received one or more grades of 0 for individual objectives). Recommended additional training does not include an X sortie.
2	Satisfactory performance -- Progress is on line with syllabus flow (received grades of 1 or better on all objectives).
3	Outstanding performance -- Progress ahead of syllabus flow (received grades that met or exceeded the desired standards specified in the Course Objectives Charts). Proficiency advance.

5. ACADEMIC EXAMINATION: Objective oriented examinations will be given in each major phase of ground training by written examination or problem solving. A score of 84 percent or below is failing. A passing grade by re-examination is required. All examinations will be corrected to 100 percent.

GENERAL INSTRUCTIONS

1. Wing commanders may authorize deviations in the order of training to meet special weather and peculiar local conditions consistent with flying safety practices, student progress, and student experience level.

2. Flying safety will be vigorously stressed via squadron flying safety meetings or presentations. Accident prevention will be based on thorough instruction, capable supervision, and strict air and ground discipline.

3. Progression: Because this syllabus is designed for the student with average (50th percentile) experience and ability, some students will require more or less training to meet required performance standards for each module. To accommodate the needs of the quick learner, proficiency advancement will be used.

4. Proficiency Advancement: To accommodate a student who demonstrates required proficiency early in a module, designated sorties (annotated by "P" next to the mission designation) may be deleted. To proficiency advance, the student must achieve the desired standards (see Course Objective Chart) of the sortie that will be proficiency advanced, and he must do it on the ride prior to the proficiency advance sortie. Additionally, the overall grade must recommend proficiency advancement.

5. "X" Missions: To accommodate a student who is unable to progress on line with syllabus flow or one who exhibits sustained inferior performance, "X" missions are provided. These missions will be dedicated to training in those tasks for which proficiency has yet to be shown; the following number of X rides per module may be given prior to an evaluation ride.

MODULE	B	C	TXA	TXB
Conversion	2	2	2	2
BAM	1	1	-	-
SA (Initial Qual/Tactical Employment)	2	2	1	-
SAT (Low/Med Threat)	1	1	1	-
SAT (High Threat)	1	1	1	-
Night Ops	1	1	1	-
DACT	1	1	-	-
Total Nr of Allowable Rides Per Student	6	4	3	2

6. Once introduced, flying tasks may be practiced on subsequent missions at IP discretion.

7. The mission descriptions listed under each phase of training contain the following information:

Mission Designation	Acft: (Number of acft in flight)
Configuration	Time: (Programmed flying time for each acft in hours)
	Ratio: (IP to student pilot ratio)

MISSION OBJECTIVE: (Broad statements covering purpose of flight)

MISSION TASKS: (Tasks essential to achieving mission objectives)

The information presented in the above format is described as follows:

a. Mission Designation: CV (Conversion); IQ (Initial Qualification); SA (Surface Attack); SAAR (Surface Attack Air Refueling); SAT (Surface Attack Tactical); NCV (Night Conversion); NSAAR (Night Surface Attack Air Refueling); BAM (Basic Attack Maneuvers); DCM (Defensive Combat Maneuvers); DDCM (Dissimilar Defensive Combat Maneuvers); DACT (Dissimilar Air Combat Training).

b. Configuration: Configurations listed are mandatory. Clean configuration consists of pylons and symmetrical empty TERS which are optional to facilitate scheduling flexibility.

c. Aircraft: In order for a sortie to be effective, it must be flown with the number of aircraft indicated (i.e., SAAR-3 may be flown as a 4, 3, or 2-ship flight while SA-2 must be flown as a 4 or 2-ship flight).

d. Time: The flying hours should be achieved as closely as possible for all sorties.

e. Ratio: 1:3 indicates that you must have a minimum of one instructor pilot for every three student pilots.

f. Mission Objectives: Specific objectives are contained in the Training Objectives Pamphlet

g. Mission Tasks: This section lists the primary tasks to be accomplished on each sortie. These are the tasks in which learning should be stressed. It does not provide a detailed mission description. A detailed breakout of each sortie is available in the appropriate briefing guide.

8. Modules: The special instructions section of each phase specifies the modules of training for each course. Mission tasks of the Conversion phase are divided into CV/B and CV/T; in all other phases the mission tasks are the same. (P) indicates the student may proficiency advance that sortie.

9. AF Form 1363, Grade Slips, are required for CPT-5, 6, all ASPT sorties, and all aircraft sorties, except IQ.

10. Ground training relies heavily on tape/slide programs in the carrel and cockpit procedures trainer. In the event that these programs are unavailable, similar information will be taught in the classroom by the Academic Section.

11. Students will fly in VMC until successful completion of initial qualification, at which time Category D minimums apply (IAW AFR 60-16).

12. A formally qualified course instructor pilot will act as flight lead or chase on all aircraft sorties except IQ which will be conducted by any standardization/evaluation flight examiner (SEFE). An instructor pilot will also be utilized on CPT-5, 6, and all ASPT sorties. CPT-7 will be conducted by a SEFE.

13. Students will fly with the same IP on CV-1 and CV-2 insofar as scheduling permits.

14. If a student exceeds four training days between flights within the initial three sorties in any phase, the last sortie flown will be reaccomplished. This is not considered an additional instructional ride in accordance with instruction 5.

15. OTD team members will conduct student evaluations on regular syllabus flights periodically to carry out internal course evaluations as required by TACR 50-31.

16. A1000B/C/TXA/TXB students must accomplish a minimum of 59.8/52.4/31.3/11.5 flying hours prior to course completion.

17. Camera systems will be used on applicable missions in accordance with AFR 95-1.

18. Briefings. Briefings are an integral part of this syllabus and include phase briefings, flight briefings, and flight debriefings.

a. Phase Briefings: These briefings are a portion of ground training and will be presented prior to class entry into a specific phase (Conversion/Surface Attack/Basic Attack Maneuvers/Surface Attack Tactical/Night Operations/Air Combat Training). Briefings will familiarize the students with the content and procedures relevant to this phase of instruction, training materials available, applicable regulations, and other procedures and techniques.

b. Flight Briefings: Immediately preceding each mission, the instructor will brief the student on the objectives of the flight and the required procedures and techniques to be applied toward accomplishing these goals.

c. Flight Debriefings: Subsequent to each flying mission, the instructor will conduct a critique on the student's individual accomplishments while pointing out both areas of needed improvement and areas of outstanding performance.

19. The following must be briefed during the CV, SAT, and ACT phase briefings:

> When planning the formation for a mission, flight leads and students should consider existing types of formation and the reasons for which they were designed. In addition, other factors bearing on the particular formation selection include: cloud conditions/visibility, maneuverability, lookout capability/techniques, search responsibilities, wingman capability, and air traffic control requirements. Of the many options available, the formation flown should best accommodate both mission objectives and flight safety.

20. The following must be briefed during the CV, SAT, and Night Operations phase briefings:

a. Three basic rules to ALL emergencies and abnormal conditions should be thoroughly understood and applied by IPs and students alike:

(1) MAINTAIN AIRCRAFT CONTROL.

(2) ANALYZE THE SITUATION AND TAKE THE PROPER ACTION.

(3) LAND AS THE EMERGENCY DICTATES.

b. IPs and students must be fully aware of the requirements for sufficient crew rest as defined in AFR 60-1 and the consequences when crew rest requirements are violated.

21. Advanced Simulator for Pilot Training (ASPT): The ASPT is a high technology visual simulator which is integrated into the course to provide interim A-10 simulator capability and to conduct research on the visual aspect of air-to-surface simulation. The program is being conducted jointly by AFHRL and TAC/OTD. (See Section D for additional information.)

A1000B

MANAGEMENT FLOW CHART

TRAINING DAY		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FLIGHT	MISSION SYMBOL															CV-1/B
	RATIO															1:1
	TIME															2.0
ASPT									ASPT Orient *AS-0	AS-1 *	AS-2 *	AS-3	AS-4 *	AS-5 *		
PART TASK TRAINER	AC	AC-1		AC-2											AC-3	
	CPT		CPT-1			CPT-2		CPT-3		CPT-4	CPT-5					
	EPT				EPT-1											
	STUDY CARREL	AG-1	AG-2 AG-3	AG-5 AG-6 AG-7	AG-9 AG-10 AG-11	AG-13		ST-4								
CLASSROOM		ST-1 ST-2 ST-3		AG-4	AG-8	AG-12 AG-14	AG-15 AG-16	ST-5							I-1	I-2

* Denotes time allocated for ASPT training/research program. AS-1 and AS-2 are prerequisites for CV-1. AS-3/4/5 may be flown prior to SA-1, but are not mandatory prerequisites for the SA phase.

TRAINING DAY		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
FLIGHT	MISSION SYMBOL		CV-2/B	CV-3/B		CV-4/B	CV-5/B	(P) CV-6/B		IQ	BAM-1	BAM-2	(P) BAM-3		SA-1	SA-[illegible]
	RATIO		1:1	1:1		1:1	1:1	1:1		1:1	1:1	1:1	1:1		1:1	2:2
	TIME		2.0	2.0		2.0	2.0	2.0		2.0	2.0	2.0	2.0		1.8	1.8
ASPT																
PART TASK TRAINER	AC															
	CPT		CPT-6		CPT-7							CPT-8				CPT-9
	EPT														EPT-2	
	STUDY CARREL					WD-12			WD-1 WD-2	WD-4 WD-5			WD-11	CW-1	CW-2	
CLASSROOM		I-3			ST-6	BFM			ST-7	WD-3	WD-6 WD-7 WD-8	WD-9	WD-10	CW-5 ST-8	CW-[illegible]	[illegible] CW-3

A1000B

MANAGEMENT FLOW CHART

TRAINING DAY		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
FLIGHT	MISSION SYMBOL	SAAR3	(P) SA-4	(P) SA-5	SA-6		SAT-1	SAT-2	SA-7	SAAR-8		(P) SA-9	SA-10	NCV	NSAAR	
	RATIO	1:3	1:3	1:3	2:2		1:2	1:2	1:1	1:3		1:3	1:3	1:1	1:3	
	TIME	2.7	1.8	1.8	1.8		1.8	1.8	1.8	2.7		1.8	1.8	1.5	2.7	
ASPT																
PART TASK TRAINER	AC															
	CPT			CPT-10						CPT-11						
	EPT															
	STUDY CARREL		TAC-3													
CLASSROOM		TAC-1 TAC-2	TAC-8	TAC-4	TAC-5 ST-9			WD-13			TAC-6	ST-10	TAC-7		TAC-9	

TRAINING DAY		46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
FLIGHT	MISSION SYMBOL		SAT-3		SAT-4	SAT-5		(P) SAT-6	SAT-7		SAT-8		SAT-9	SAT-10		DCM
	RATIO		1:1		1:2	1:2		1:2	1:1		1:1		1:1	1:1		2:2
	TIME		1.8		1.8	1.8		1.8	1.8		1.8		1.8	1.8		1.8
ASPT																
PART TASK TRAINER	AC									AC-4						
	CPT															
	EPT										EPT-3					
	STUDY CARREL															
CLASSROOM		TAC-10 TAC-11		TAC-12 TAC-13		TAC-14		TAC-15	TAC-17	TAC-18	TAC-19	TAC-20		TAC-21	ST-11 TAC-22	IN-1 IN-2

A1000B

MANAGEMENT FLOW CHART

TRAINING DAY		61	62	63	64	65	66	67	68	69	70	71				
FLIGHT	MISSION SYMBOL		DDCM	DACT	DACT/ SAT		SAT-11									
	RATIO		1:1	1:1	1:1		1:1									
	TIME		1.8	1.8	1.8		1.8									
ASPT								ASPT	ASPT	ASPT	ASPT	ASPT				
PART TASK TRAINER	AC			AC-5												
	CPT															
	EPT															
	STUDY CARREL															
CLASSROOM		IN-3	IN-4 TAC-16													

A1000C

MANAGEMENT FLOW CHART

TRAINING DAY		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FLIGHT	MISSION SYMBOL							CV-1/T		CV-2/T	CV-3/T		CV-5/B	(P) CV-6/B	IQ	
	RATIO							1:1		1:1	1:1		1:1	1:1	1:1	
	TIME							2.0		2.0	2.0		2.0	2.0	2.0	
ASPT																
PART TASK TRAINER	AC	AC-1		AC-2		AC-3										
	CPT		CPT-1	CPT-2	CPT-3	CPT-4	CPT-5				CPT-6	CPT-7				
	EPT				EPT-1											
	STUDY CARREL	AG-1	AG-2 AG-3	AG-5 AG-6 AG-7	AG-9 AG-10 AG-11	AG-13							WD-12		WD-1 WD-2	WD-4 WD-5
CLASSROOM		ST-1 ST-2 ST-3		AG-4	AG-8	AG-12 AG-14 ST-4	AG-15 AG-16 I-1 ST-5		I-2	I-3		ST-6	BFM	ST-7		WD-3

TRAINING DAY		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
FLIGHT	MISSION SYMBOL	BAM-1	BAM-2	(P) BAM-3		SA-1	SA-2		SAAR3	(P) SA-4	(P) SA-5	SA-6		SA-7	SAAR-8	(P) SA-9
	RATIO	1:1	1:1	1:1		1:1	2:2		1:3	1:3	1:3	2:2		1:1	1:3	1:3
	TIME	2.0	2.0	2.0		1.8	1.8		2.7	1.8	1.8	1.8		1.8	2.7	1.8
ASPT																
PART TASK TRAINER	AC															
	CPT		CPT-8					CPT-9								CPT-11
	EPT					EPT-2										
	STUDY CARREL			WD-11										CW-1	CW-2	
CLASSROOM		WD-6 WD-7 WD-8	WD-9	WD-10 ST-8									WD-13	CW-5	CW-4	CW-6 CW-3

A1000C

MANAGEMENT FLOW CHART

TRAINING DAY		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
FLIGHT	MISSION SYMBOL		SA-10	NCV	NSAAR	SAT-2		SAT-3	SAT-4		(P) SAT-5	SAT-7		(P) SAT-8	SAT-9	
	RATIO		1:3	1:1	1:3	1:2		1:1	1:2		1:2	1:1		1:1	1:1	
	TIME		1.8	1.5	2.7	1.8		1.8	1.8		1.8	1.8		1.8	1.8	
ASPT																
PART TASK TRAINER	AC									AC-4						
	CPT			CPT-10												
	EPT													EPT-3		
	STUDY CARREL		TAC-3													
CLASSROOM		TAC-1 TAC-2	TAC-8 ST-10	TAC-4	TAC-5 ST-9	TAC10 TAC11	TAC-6	TAC-7	TAC-9	TAC12 TAC13	TAC_{14}	TAC-15 TAC-17	TAC18	TAC19	TAC-20	TAC-21

TRAINING DAY		46	47	48	49	50	51	52	53	54	55	56	57			
FLIGHT	MISSION SYMBOL	SAT-10		DCM		DDCM	DACT	DACT/SAT		SAT-11						
	RATIO	1:1		2:2		1:1	1:1	1:1		1:1						
	TIME	1.8		1.8		1.8	1.8	1.8		1.8						
ASPT											ASPT	ASPT	ASPT			
PART TASK TRAINER	AC								AC-5							
	CPT															
	EPT															
	STUDY CARREL															
CLASSROOM		TAC22 ST-11	IN-1 IN-2	IN-3	IN-4 TAC16											

A10001XA

MANAGEMENT FLOW CHART

TRAINING DAY		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FLIGHT	MISSION SYMBOL							[illegible]-1 T		[illegible]-2-T	[illegible]-3 T		[illegible]-4 T	(P) [illegible]-5 T	[illegible]	
	RATIO							1:1		1:1	1:1		1:1	1:1	1:1	
	TIME							2.0		2.0	2.0		2.0	2.0	2.0	
ASPT																
PART TASK TRAINER	AG	AG-1		AG-2		AG-3										
	CPT		CPT-1	CPT-2	CPT-3	CPT-4	CPT-5			CPT-6		CPT-[illegible]	CPT-7			
	EPT				EPT-1											
	STUDY CARREL	AG-1	[illegible]	AG-5 AG-6 AG-7	AG-9 AG-10 AG-11	AG-1[illegible]				WD-1 WD-2	WD-4 WD-5			WD-11	CW-1	TAC-[illegible] CW-2
CLASSROOM		[illegible]		AG-4	AG-8	ST-4 AG-12 AG-14	AG-15 AG-16 ST-1 ST-5	I-2	I-3		WD-[illegible]	WD-7 WD-8	ST-6	WD-10 ST-[illegible]	CW-5	CW-4

TRAINING DAY		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
FLIGHT	MISSION SYMBOL	SA-1	SA-[illegible]	SAAP-3	(P) SA-4	SA-7	SA-10		NCV	NSAAP		SAT-4	SAT-5		SAT-7	
	RATIO	1:1	1:1	1:3	1:3	1:1	1:3		1:1	1:3		1:2	1:2		1:1	
	TIME	1.8	1.8	2.7	1.8	1.8	1.8		1.5	2.7		1.8	1.8		1.8	
ASPT																
PART TASK TRAINER	AG															
	CPT						CPT-11			CPT-10						
	EPT						EPT-2									
	STUDY CARREL															
CLASSROOM		CW-6 CW-3	TAC-1 TAC-2	TAC-7 WD-13	TAC-8 TAC10	TAC-9 TAC11	ST-10	TAC12 TAC13	TAC14	ST-9	TAC15	TAC17	TAC18	TAC19	TA[illegible]	TAC[illegible]

A1000TXA

MANAGEMENT FLOW CHART

TRAINING DAY		31	32	33												
FLIGHT	MISSION SYMBOL	SAT-10														
	RATIO	1:1														
	TIME	1.8														
ASPT			ASPT	ASPT												
PART TASK TRAINER	AC															
	CPT															
	EPT															
	STUDY CARREL															
CLASSROOM																

A1000TXB

MANAGEMENT FLOW CHART

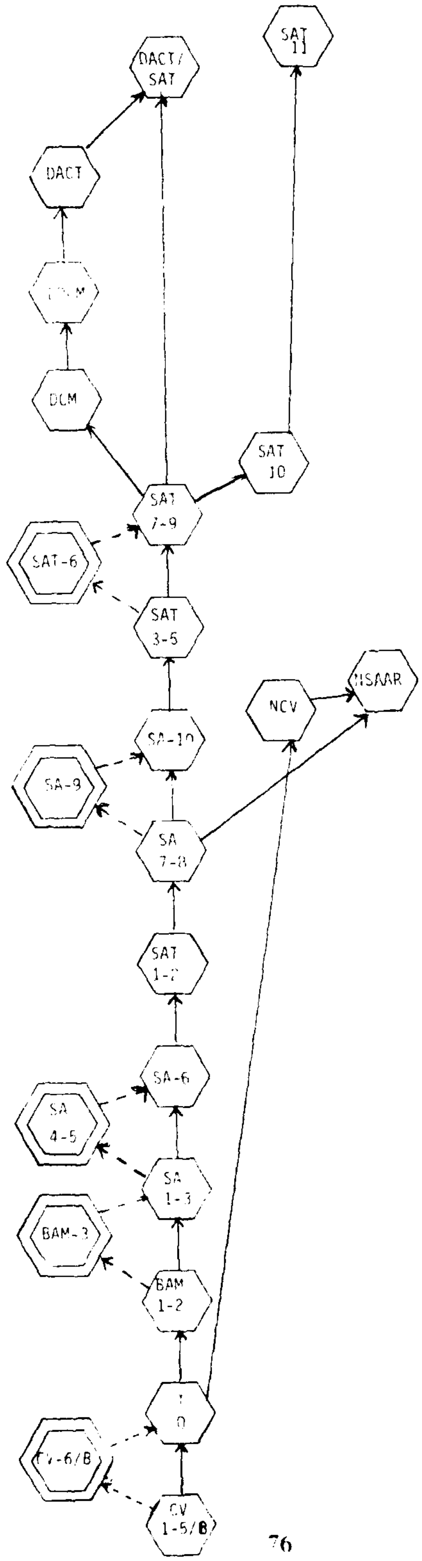
TRAINING DAY		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FLIGHT	MISSION SYMBOL							CV-1/T		CV-2/T	CV-3/T		CV-4/T	(P) CV-5/T		IQ
	RATIO							1:1		1:1	1:1		1:1	1:1		1:1
	TIME							2.0		2.0	2.0		2.0	2.0		2.0
ASPT																
PART TASK TRAINER	AC	AC-1		AC-2		AC-3										
	CPT		CPT-1	CPT-2	CPT-3	CPT-4	CPT-5				CPT-6	CPT-7				
	EPT				EPT-1											
	STUDY CARREL	AG-1	AG-2 AG-3	AG-5 AG-6 AG-7	AG-9 AG-10 AG-11	AG-13										
CLASSROOM		ST-1 ST-2 ST-3		AG-4	AG-8	ST-4 AG-12 AG-14	AG-15 AG-16 I-1 ST-5					ST-6				

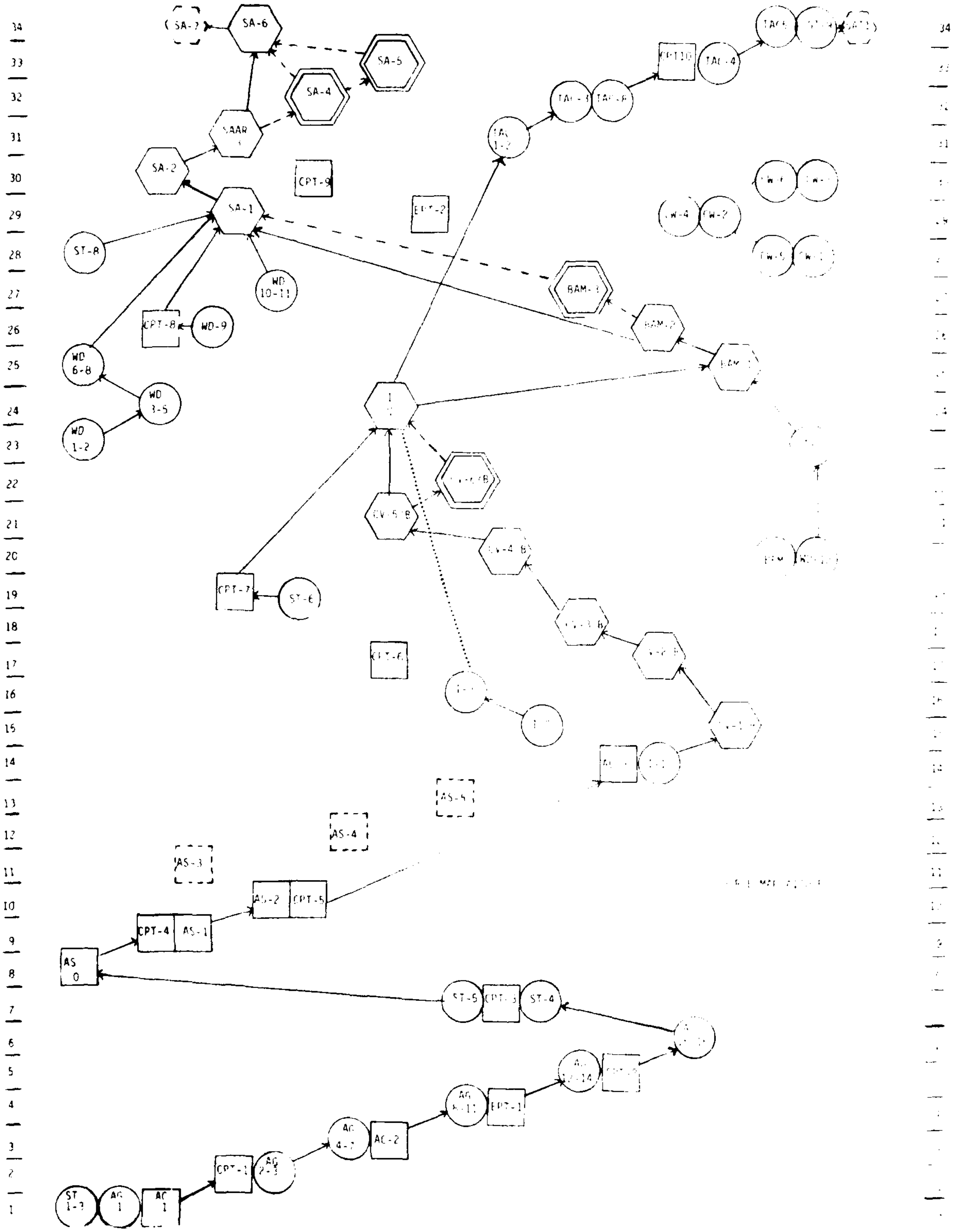
TRAINING DAY		16	17	18												
FLIGHT	MISSION SYMBOL		NCV													
	RATIO		1:1													
	TIME		1.5													
ASPT																
PART TASK TRAINER	AC															
	CPT															
	EPT															
	STUDY CARREL															
CLASSROOM		ST-10														

74 — [illegible]

COURSE FLIGHT SEQUENCE

A1000B

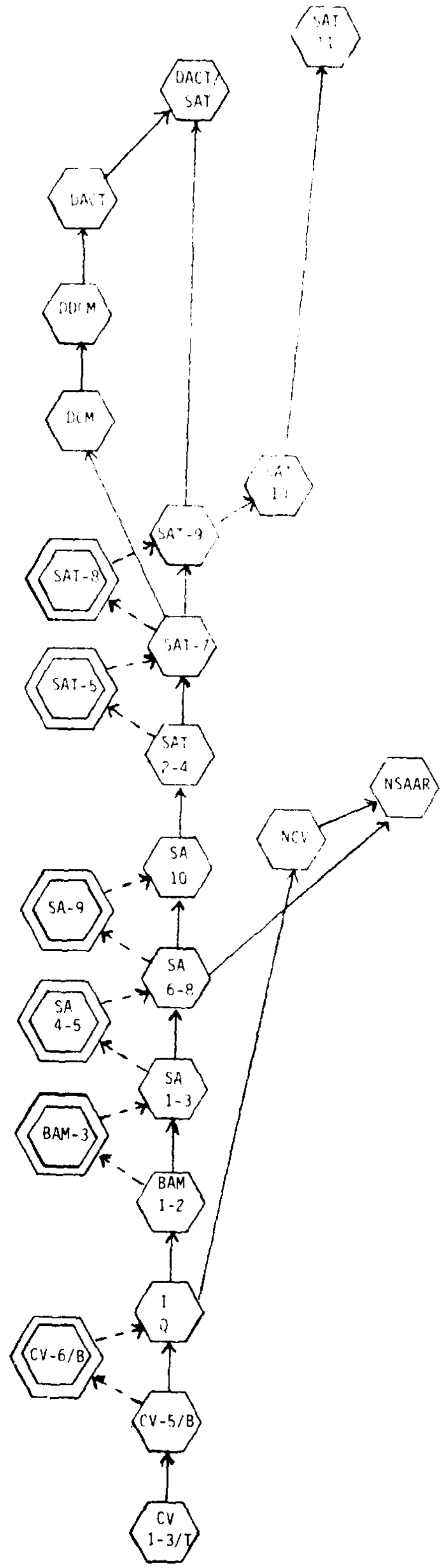



SA-6
SA-5
SA-4
SAAR
SA-2
SA-1
CPT-9
ST-8
WD 10-11
CPT-8
WD-9
WD 6-8
WD 3-5
WD 1-2
BAM-3
CW-4
CW-2
TAC-4
CPT-7
ST-6
AS-5
AS-4
AS-3
AS-2
CPT-5
CPT-4
AS-1
AS 0
ST-5
ST-4
AG 4-7
AC-2
CPT-1
ST 1-3
AG 1
AC 1

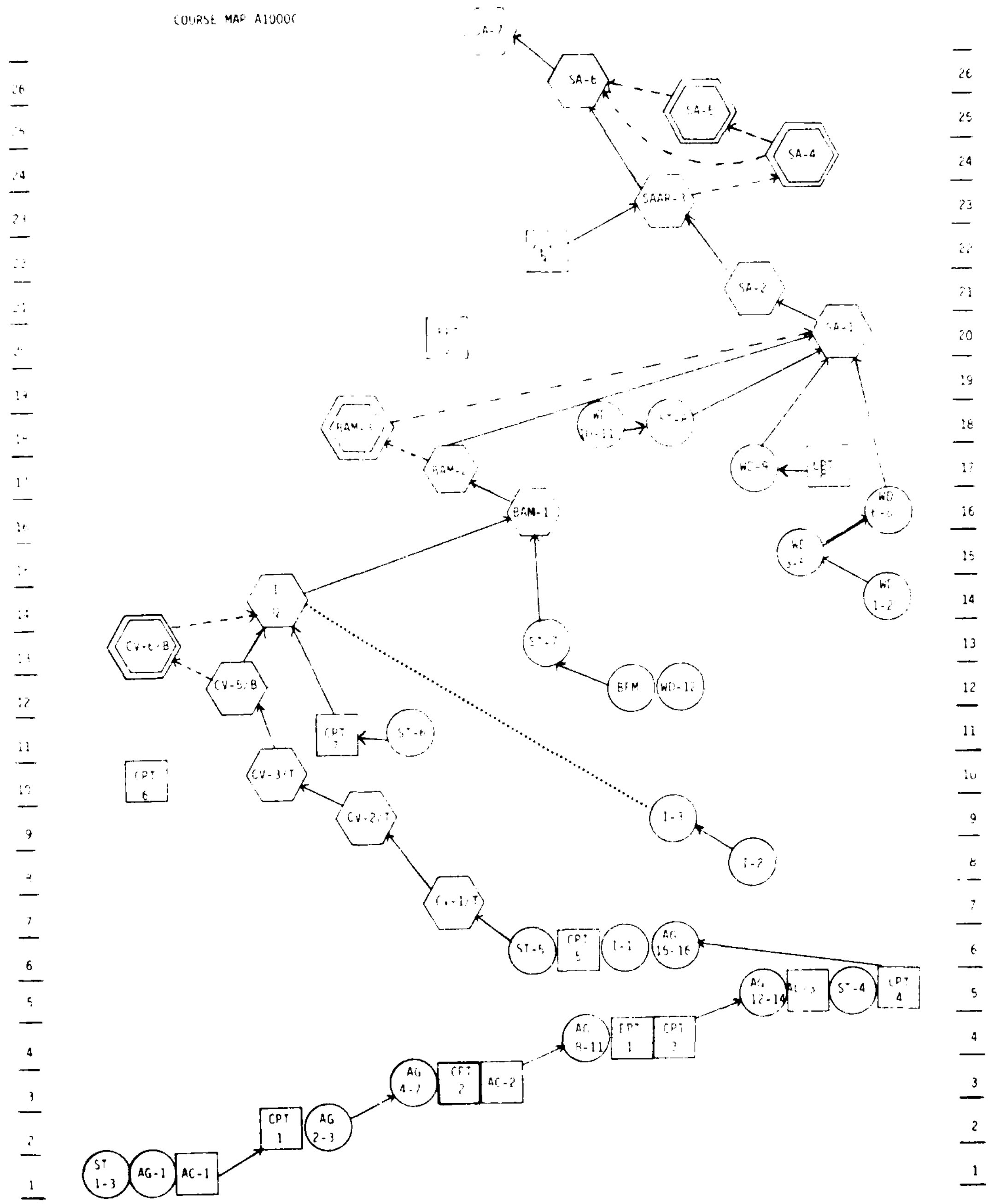
78 - 79

COURSE FLIGHT SEQUENCE

A1000C



COURSE MAP A1000C



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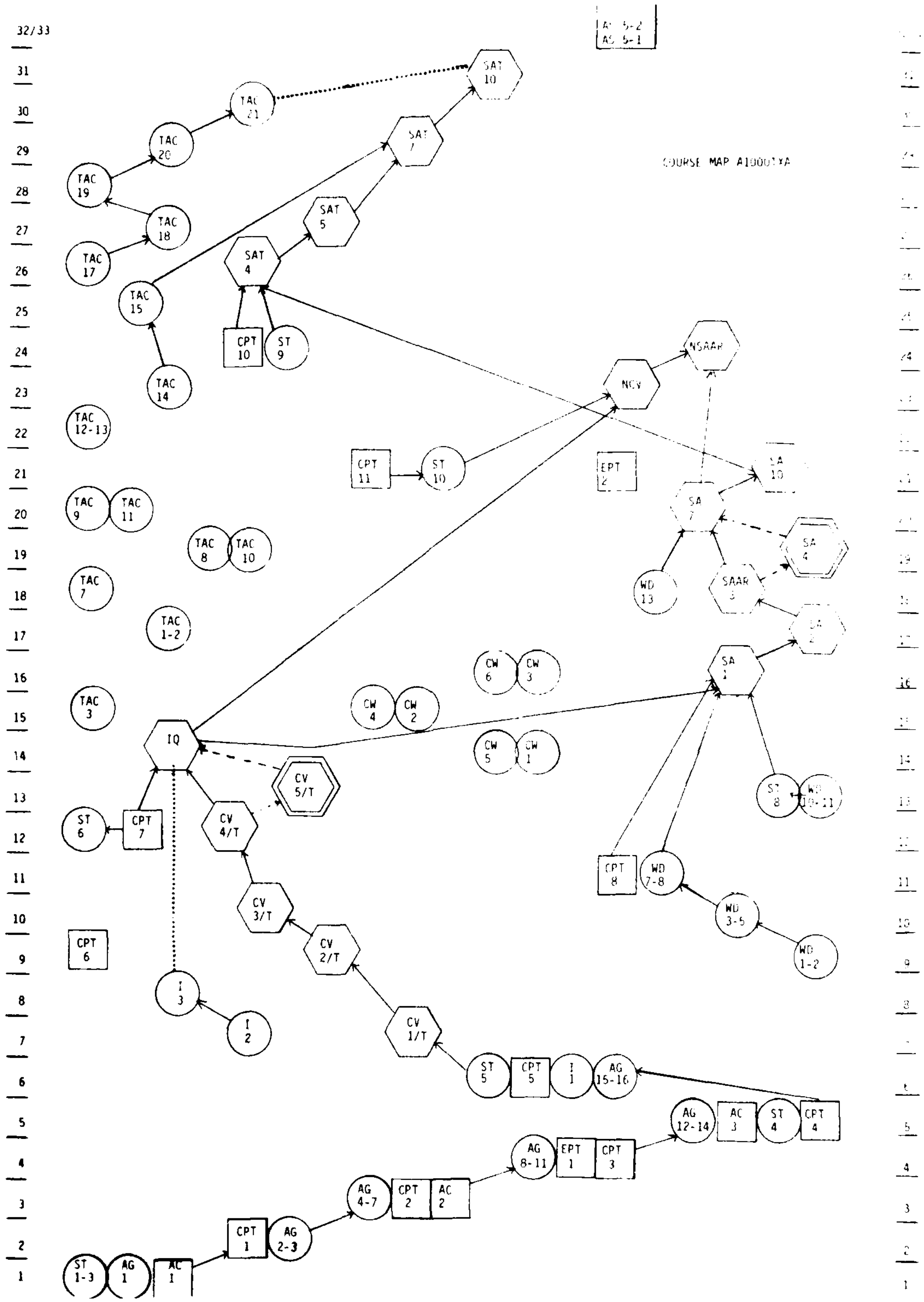
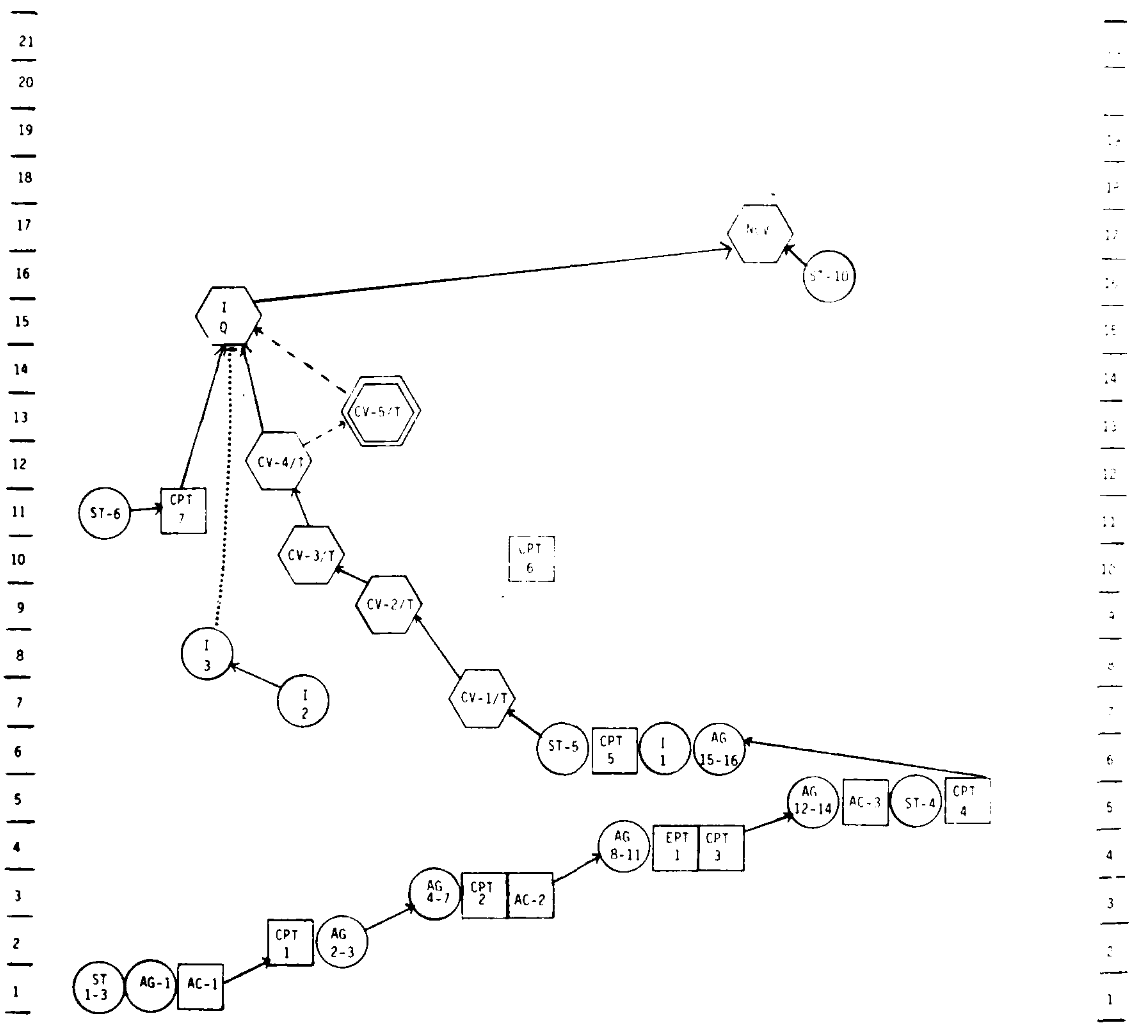
82 x 12



COURSE MAP A1000IXA
TAC 21
SAT 10
TAC 20
SAT 7
TAC 19
TAC 18
SAT 5
TAC 17
SAT 4
TAC 15
CPT 10
ST 9
TAC 14
NSAAR
NCV
TAC 12-13
CPT 11
ST 10
EPT 2
SA 10
SA 7
TAC 9
TAC 11
TAC 8
TAC 10
SA 4
WD 13
SAAR 3
TAC 7
TAC 1-2
SA 2
CW 6
CW 3
SA 1
CW 4
CW 2
TAC 3
IQ
CW 5
CW 1
CV 5/T
ST 8
WD 10-11
ST 6
CPT 7
CV 4/T
CPT 8
WD 7-8
CV 3/T
WD 3-6
CV 2/T
CPT 6
WD 1-2
I 3
I 2
CV 1/T
ST 5
CPT 5
I 1
AG 15-16
AG 12-14
AC 3
ST 4
CPT 4
AG 8-11
EPT 1
CPT 3
AG 4-7
CPT 2
AC 2
CPT 1
AG 2-3
ST 1-3
AG 1
AC 1

COURSE MAP

A1:00TXB



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[illegible]

AG-5 Tape/Slide
Carrel 1 Hour

COMMUNICATIONS AND AVIONICS EQUIPMENT: Intercom system; UHF radio system; VHF/AM system; VHF/FM system; head-up display system; heading attitude reference system; HSI/ADI; TACAN system; IFF/SIF system.

AG-6 Tape/Slide
Carrel 1.5 Hours

HYDRAULICALLY SERVICED SYSTEMS: Normal and emergency operations for the following sub-systems: landing gear, nose wheel steering, wheel brakes, antiskid, wing flaps, wing slats, and speed brake system; hydraulic power supply and distribution.

AG-7 Tape/Slide
Carrel 1 Hour

PRIMARY FLIGHT CONTROLS: Hydraulic pitch, roll, and yaw control; trim; manual reversion flight control system; surface jam procedures; stability augmentation system (SAS).

AG-8 Seminar
Classroom 2 Hours

REVIEW & TEST: AG 5-7.

AG-9 Tape/Slide
Carrel 1 Hour

BLEED AIR SYSTEM: Sources and distribution; cockpit controls; normal and emergency procedures.

AG-10 Tape/Slide
Carrel 0.5 Hour

LIGHTING SYSTEM: Exterior and interior configurations; panel controls; exterior throttle control.

AG-11 Tape/Slide
Carrel 1 Hour

FUEL SYSTEM: Tank location; refueling manifold; tank capacities; quantity indicators; feed sequencing; fuel management; malfunctions (indications and procedures); air refueling sub-system.

AG-12 Seminar
Classroom 2 Hours

REVIEW: AG 9-11.

AG-13 Tape/Slide
Carrel 1 Hour

AIRCRAFT HANDLING CHARACTERISTICS: Pitch/roll/yaw control; straight wing flight characteristics at high AOAs and near stalls; stall warning system; power on/power off stall characteristics; spins; manual reversion; engine characteristics.

AG-14 Lecture
Classroom 1.5 Hours

EMERGENCY PROCEDURES: Discussion and review of all Bold Face and selected non-Bold Face emergency procedures.

AG-15 Examination
Classroom 1 Hour

AIRCRAFT GENERAL EXAMINATION.

AG-16 Lecture
Classroom 2 Hours

PERFORMANCE CHARTS: Takeoff; climb; cruise; maximum endurance; landing.

INSTRUMENTS

I-1 Lecture
Classroom 1 Hour

INSTRUMENTS: A-10 instrument procedures.

I-2 (If required) Lecture
Classroom 4 Hours

INSTRUMENTS: Basic instruments; navigation; flight preparation; preflight ground operations; takeoff; departure; TACAN and GCA procedures; AFR 60-16; FLIP.

I-3 (If required) Lecture/Examination
Classroom 4 Hours

INSTRUMENTS: Spatial disorientation; computer; IFR emergency situations; weather.

* * * *

90 — 91.

CW-6 Classroom	Examination 1 Hour

MAVERICK EXAMINATION.

INTELLIGENCE

IN-1 Classroom	Lecture 1 Hour

COLLECTION AND REPORTING.

IN-2 Classroom	Lecture 1 Hour

ESCAPE AND EVASION.

IN-3 Classroom	Lecture 2 Hours

INTELLIGENCE REVIEW.

IN-4 Classroom	Examination 2 Hours

TAC INTELLIGENCE EXAMINATION.

TACTICS

TAC-1 Classroom	Lecture 0.5 Hour

INTRODUCTION TO TACTICS COURSE.

TAC-2 Classroom	Lecture 3 Hours

AIR GROUND OPERATIONS SCHOOL.

TAC-3 Carrel	Tape/Slide 0.5 Hour

A-10 SURVIVABILITY FEATURES.

TAC-4 Classroom	Lecture 2 Hours

REDUCED THREAT TACTICS, PART I.

TAC-5
Classroom

Seminar
1 Hour

REDUCED THREAT TACTICS, PART II.

TAC-6
Classroom

Lecture
2 Hours

PRINCIPLES OF THREAT RADARS.

TAC-7
Classroom

Lecture
2.5 Hours

ALR-46A AND ECM.

TAC-8
Classroom

Lecture
1 Hour

SOVIET ANTI-AIRCRAFT ARTILLERY.

TAC-9
Classroom

Lecture
2 Hours

SOVIET SURFACE TO AIR MISSILES.

TAC-10
Classroom

Lecture
1 Hour

SOVIET FIGHTER AIRCRAFT.

TAC-11
Classroom

Lecture
0.5 Hour

SOVIET COMMUNICATIONS JAMMING.

TAC-12
Classroom

Lecture
1 Hour

ALLIED SURFACE TO AIR MISSILES AND ANTI-AIRCRAFT ARTILLERY.

TAC-13
Classroom

Lecture
1.5 Hours

ARMOR ALONG THE FEBA.

TAC-14
Classroom

Lecture
2 Hours

HIGH THREAT TACTICS, PART I.

94 - 95

CPT-9

Tape/Slide
0.5 Hour

REVIEW OF AG-11 AIR REFUELING SLIDE/TAPE PROGRAM IN CPT.

CPT-10

Tape/Slide
0.5 Hour

MAVERICK REVIEW.

CPT-11

Tape/Slide
0.5 Hour

REVIEW OF AG-10 LIGHTING PROGRAM IN CPT.

AIRCRAFT COCKPIT

AC-1
Flightline

1:4 Ratio
1 Hour

AIRCRAFT FAMILIARIZATION: Preflight check and exterior inspection demonstration; cockpit orientation.

AC-2
Flightline

0:1 Ratio
1 Hour

AIRCRAFT CHECKLIST PRACTICE: Preflight check; exterior inspection; before entering cockpit; interior inspection; prior to engine start; after clearing runway; engine shutdown; before leaving airplane; before leaving area.

AC-3
Flightline

1:1 Ratio
1 Hour

SUPERVISED START: All AC-2 checks; starting engines; before taxiing; before takeoff.

AC-4
Flightline

1:4 Ratio
1 Hour

PREFLIGHT HEAVYWEIGHT ORDNANCE: Student demonstrates heavyweight ordnance preflight. Student demonstrates ability to locate and identify weapons' load errors.

AC-5 (If SAT-11 is flown)
Flightline

1:4 Ratio
1 Hour

PREFLIGHT LIVE ORDNANCE: Student demonstrates proficiency in live ordnance preflight.

EGRESS PROCEDURES TRAINER (EPT)

EPT-1 | Exercise
Life Support | 1 Hour

LIFE SUPPORT: Emergency ground egress procedures; ejection and canopy jettison procedures; hanging harness.

EPT-2 | Exercise
Life Support | 0.5 Hour

EGRESS REVIEW.

EPT-3 | Exercise
Life Support | 0.5 Hour

EGRESS REVIEW.

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SECTION E

FLYING TRAINING

CONVERSION

SPECIAL INSTRUCTIONS

1. Modules:

MSN	B	C	TXA/TXB
1	CV-1/B	CV-1/T	CV-1/T
2	CV-2/B	CV-2/T	CV-2/T
3	CV-3/B	CV-3/T	CV-3/T
4	CV-4/B	CV-5/B	CV-4/T
5	CV-5/B	(P) CV-6/B	(P) CV-5/T
6	(P) CV-6/B	IQ	IQ
7	IQ		

2. The following is the minimum number of approaches that must be flown during the Conversion phase. Mission tasks are the minimum for each ride. Instructor pilots are encouraged to provide additional approach practice if fuel permits.

APPROACH	MINIMUM NUMBER		
	B	C	TXA/B
Normal . .	7	5	5
Sim Single Engine	3	2	2
No Flap	3	2	2
TACAN	3	2	2
GCA	2	2	2
ILS*	2	2	2

*ILS approaches are not required until the equipment is installed in the aircraft.

3. Students will be given an initial qualification/proficiency/instrument evaluation check (IQ) in accordance with AFR 60-1. This check will be administered by the Wing Stan/Eval Section in accordance with TACR 60-2 and applicable directives.

4. Basic Attack Maneuvers (BAM) are flown in lieu of aerobatics (except for familiarization). These maneuvers are designed to approximate attack maneuvers that will be flown in the Surface Attack and Surface Attack Tactical phases. BAM procedures are outlined in the phase manual. The minimum altitude for BAM in the Conversion phase is 500 feet AGL.

5. The landing portion of CV-1 and CV-2 for A1000B students and CV-1 for A1000C/TXA/TXB students will be monitored by an A-10 instructor pilot from the RSU.

6. If four-ship formation is not accomplished on CV-4/B or CV-3/T, it must be accomplished on a subsequent CV sortie.

CONVERSION

CV-1/B
Clean

Acft: 2
Time: 2.0
Ratio: 1.1

MISSION OBJECTIVE: Introduce ground operations, basic transition, formation, and instrument procedures.

MISSION TASKS: Ground operations (supervised up to before taxiing); takeoff (chased); stall recoveries (1 G level, power-on, traffic pattern); slow flight; route/close formation; formation speed brake exercise; gear and flap exercise; enroute descent; GCA pattern and approach; TACAN approach (penetration not required); missed approach; landing from instrument approach.

* * * *

CV-2/B
Clean

Acft: 2
Time: 2.0
Ratio: 1:1

MISSION OBJECTIVE: Provide aerobatics familiarization. Practice formation and instrument procedures. Introduce overhead and no-flap traffic patterns.

MISSION TASKS: Takeoff (chased); stall recoveries (traffic pattern); lazy eight; chandelle; aileron roll; barrel roll; split "S"; loop; cloverleaf; immelmann; route/close formation; steep turns; TACAN holding; TACAN penetration and approach; VFR reentry; normal overhead pattern and approach; closed pattern; no-flap approach; landing.

* * * *

CV-3/B
Clean

Acft: 2
Time: 2.0
Ratio: 1:1

MISSION OBJECTIVE: Practice formation maneuvers. Introduce BAM and single engine maneuvers. Introduce single engine traffic patterns.

MISSION TASKS: Takeoff (chased); BAM (turn radius, tracking, 30-degree dive, minimum exposure); simulated single engine maneuvering/go-around at altitude; route/close/fighting wing formation; pitchouts/rejoins; enroute descent; normal approach; closed pattern; no-flap approach; simulated single engine approach; simulated single engine go-around; landing.

* * * *

CV-4/B
Clean

Acft: 4 or 2
Time: 2.0
Ratio: 1:1

MISSION OBJECTIVE: Practice BAM and traffic patterns. Introduce 4-ship formation and degraded flight control characteristics.

MISSION TASKS: Wing formation takeoff; 4-ship route/close formation; 2-ship route/close/fighting wing/close trail formation; pitchouts/rejoins; BAM (turn radius, 30-degree dive, 20-degree dive); SAS exercise; manual reversion exercise; ILS approach; normal approach; closed pattern; no-flap approach; simulated single engine approach; landing.

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BASIC ATTACK MANEUVERS

SPECIAL INSTRUCTIONS

1. Modules:

MSN	B	C	TXA/B
1	BAM-1	BAM-1	--
2	BAM-2	BAM-2	--
3	(P) BAM-3	(P) BAM-3	--

2. The BAM phase is designed to familiarize the student with the basic elements of the attack fighter role. They include low-level navigation, basic fighter maneuvers (BFM), and basic attack maneuvers (BAM).

3. The minimum altitude will be briefed and adhered to for each basic attack maneuver (BAM). Based on student proficiency and IP discretion, incremental altitudes may be lowered during a sortie. Three hundred (300) feet is the minimum altitude for the phase. The student will be chased during BAM.

4. Low levels are to be flown at 500 feet.

BAM-1 | Acft: 2
Clean | Time: 2.0
Ratio: 1:1

MISSION OBJECTIVE: Introduce low-level navigation, BFM, tactical formation, and advanced BAM.

MISSION TASKS: Low-level navigation; tactical formation (delayed 90/45's, in-place, cross); BAM (pop-up, jink, diamond); BFM (L/D turns, hard turns, breaks, yo-yo's, reversals); formation landing.

* * * *

BAM-2 | Acft: 2
Clean | Time: 2.0
Ratio: 1:1

MISSION OBJECTIVE: Practice low-level navigation, BAM, and BFM.

MISSION TASKS: Low-level navigation; tactical formation (delayed 90/45's, in-place, cross); BAM (pop-up, jink, diamond); BFM (L/D turns, hard turns, breaks, yo-yo's, reversals); instrument approach.

* * * *

BAM-3 | Acft: 2
Clean | Time: 2.0
Ratio: 1:1

MISSION OBJECTIVE: Practice low-level navigation, BAM, and BFM.

MISSION TASKS: Low-level navigation; tactical formation (delayed 90/45's, in-place, cross); BAM (pop-up, jink, diamond); BFM (L/D turns, hard turns, breaks, yo-yo's, reversals); normal overhead pattern and approach.

AD-A094 608 AIR FORCE HUMAN RESOURCES LAB BROOKS AFB TX F/G 5/9
ADVANCED FLIGHT SIMULATOR: UTILIZATION IN A-10 CONVERSION AND A--ETC(U)
JAN 81 T H GRAY, E K CHUN, H D WARNER
UNCLASSIFIED AFHRL-TR-80-20 NL

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SURFACE ATTACK

SPECIAL INSTRUCTIONS

LATN/LATF Range Operations

1. Modules:

MSN	B	C	TXA	TXB
1	SA-1	SA-1	SA-1	-
2	SA-2	SA-2	SA-2	-
3	SAAR-3	SAAR-3	SAAR-3	-
4	(P) SA-4	(P) SA-4	(P) SA-4	-
5	(P) SA-5	(P) SA-5	SA-7	-
6	SA-6	SA-6	SA-10	-
7	SA-7	SA-7		-
8	SAAR-8	SAAR-8		-
9	(P) SA-9	(P) SA-9		-
10	SA-10	SA-10		-

2. If rockets are not available on SA-2, they may be scheduled on any subsequent SA mission. An empty LAU may be carried on any SA sortie.

3. Low altitude tactical navigation (LATN) stresses low altitude pilotage with minimum reference to time and distance criteria. For training purposes, LATN is flown at and below 500 feet AGL/ 250 KIAS. A 50 NM minimum route must be flown to log a LATN event. LATN events may be flown to and from the objective area (range). The student will not descend below the incremental altitude indicated for the number of events on the following chart. Thereafter, the student may descend to a minimum of 100 feet AGL based on demonstrated student proficiency and instructor pilot discretion. The appropriate flying training squadron will have a certification program for LATN and LATF.

4. Minimum number of LATN events at incremental altitudes:

NUMBER OF EVENTS

ALTITUDE	B	C	TXA	TXB
500'	2	2	1	-
300'	2	2	2	-

5. In a 1:3 or 1:2 ratio flight, the student leading a LATN event will be chased by the instructor pilot. Remaining students will fly in staggered-trail, observation position, at 1,000-1,500 feet AGL, with approximately 2,000 feet fore/aft spacing between the instructor pilot and each trailing student.

6. Low altitude tactical formation (LATF) will be flown in the SA and SAT phases once the student is proficient at 500 feet LATN. The formation for 1:3 or 1:2 ratio flights is one student flies LATN with another student flying LATF; the instructor, leader of the second element, flies close enough to monitor the lead element. The remaining student flies LATF on the instructor. The student will not progress to an incremental altitude lower in LATF than he has progressed to in LATN. The minimum altitude is 100 feet. The minimum number of LATF incremental altitudes is:

NUMBER OF EVENTS

ALTITUDE	B	C	TXA	TXB
500'	2	2	1	-
300'	3	3	2	-

7. Pop-up patterns will be chased on SA-7 and performed without chase prior to accomplishing them on the uncontrolled range.

8. Minimum strafe events:

EVENT	B	C	TXA	TXB
LAS (5-15 deg)	Qual	Qual	Qual	-
LAS (Pop-up/0-5 deg)	2/2	2/2	1/1	-
LRS	2	2	1	-
TTS	1	1	1	-
HAS	1	1	1	-

9. BDU-33's may be used in lieu of MK-106's until they become certified and available.

Air Refueling

10. Programmed off-load should be 1,000 pounds minimum.

11. Student pilots will not conduct air refueling in a turn until proficiency in level flight has been demonstrated.

12. Air refueling will be conducted in VMC.

13. In accordance with TACR 55-110, air refueling will not be conducted with both the receiver pilot and boom operator in student status. The flight leader will coordinate with the tanker crew to assure compliance prior to any aircraft assuming the pre contact position.

14. Air refueling is scheduled for SAAR-3 and SAAR-8. However, it may be accomplished on any subsequent SA or SAT mission.

INITIAL WEAPONS QUALIFICATION

SA-1
12 BDU-33
108 RND 30MM

Acft: 2
Time: 1.8
Ratio: 1:1

MISSION OBJECTIVE: Practice low-level navigation. Introduce basic weapons delivery and LATN.

MISSION TASKS: Wing formation takeoff; low level navigation; DB; LALD; LAB; 30MM LAS; primary recovery field familiarization; LATN; hung ordnance pattern; landing.

* * * *

SA-2
6 BDU-33
6 MK-106
108 RND 30MM
4-2.75 RX

Acft: 4 or 2
Time: 1.8
Ratio: 2:2

MISSION OBJECTIVE: Practice LATN. Introduce RX and level LAB. Initial weapons qualification tion IAW MCM 51-50.

MISSION TASKS: LATN; level LAB; LAB; LALD; DB; RX; 30MM LAS; formation landing.

* * * *

SAAR-3
6 BDU-33
6 MK-106
2 X 108 RND 30MM

Acft: 4, 3, or 2
Time: 2.7
Ratio: 1:3

MISSION OBJECTIVE: Introduce air refueling, HAS/Pave Penny, and LATF. Initial weapons qualification IAW MCM 51-50.

MISSION TASKS: Air refueling; LAB; LALD; DB; 30MM HAS/Pave Penny; 30MM LAS; LATN/LATF.

* * * *

SA-4
6 BDU-33
6 MK-106
108 RND 30MM

Acft: 4, 3, or 2
Time: 1.8
Ratio: 1:3

MISSION OBJECTIVE: Practice LATN/LATF. Initial weapons qualification IAW MCM 51-50.

MISSION TASKS: LATN/LATF; LAB; LALD; DB; 30MM LAS.

* * * *

SA-5
6 BDU-33
6 MK-106
108 RND 30MM

Acft: 4, 3, or 2
Time: 1.8
Ratio: 1:3

MISSION OBJECTIVE: Practice LATN/LATF. Initial weapons qualification IAW MCM 51-50.

MISSION TASKS: LATN/LATF; LAB; LALD; DB; 30MM LAS.

* * * *

SA-6
6 BDU-33
6 MK-106
108 RND 30MM

Acft: 4 or 2
Time: 1.8
Ratio: 2:2

MISSION OBJECTIVE: Practice LATN/LATF. Initial weapons qualification IAW MCM 51-50.

MISSION TASKS: Wing formation takeoff; LATN/LATF; LAB; LALD; DB; 30MM LAS; TACAN approach; normal overhead pattern and landing.

TACTICAL EMPLOYMENT

SA-7
6 BDU-33
6 MK-106
2 X 108 RND 30MM

Acft: 4 or 2
Time: 1.8
Ratio: 1:1

MISSION OBJECTIVE: Introduce pop-up patterns and LRS. Practice LATN/LATF.

MISSION TASKS: LATN/LATF; pop-up patterns (chased); LAB (pop-up); LALD (pop-up); 30MM LAS (pop-up), 30MM LRS.

SAAR-8
6 BDU-33
6 MK-106
2 X 108 RND 30MM

Acft: 4, 3, or 2
Time: 2.7
Ratio: 1:3

MISSION OBJECTIVE: Practice air refueling and LATN/LATF. Practice pop-up patterns and LRS. Introduce minimum run landing.

MISSION TASKS: Air refueling; LAB (pop-up); LALD (pop-up); 30MM LAS (pop-up); 30MM LRS; remaining events to qual; LATN/LATF; minimum run landing.

* * * *

SA-9
6 BDU-33
6 MK-106
2 X 108 RND 30MM

Acft: 4, 3, or 2
Time: 1.8
Ratio: 1:3

MISSION OBJECTIVE: Practice LATN/LATF. Practice pop-ups. Introduce 30MM LAS (0-5 degrees).

MISSION TASKS: LATN/LATF; LAB (pop-up); LALD (pop-up); 30MM LRS; 30MM LAS (0-5 degrees); remaining events to qual.

* * * *

SA-10
6 BDU-33
6 MK-106
2 X 108 RND 30MM

Acft: 4, 3, or 2
Time: 1.8
Ratio: 1:3

MISSION OBJECTIVE: Practice LATN/LATF, pop-ups, and 30MM LAS (0-5 degrees). Introduce two target strafe (TTS). Introduce simulated single engine landing.

MISSION TASKS: LATN/LATF; LAB (pop-up); LALD (pop-up); 30MM LAS (0-5 degrees); 30MM TTS; remaining events to qual; simulated single engine landing.

SURFACE ATTACK TACTICAL

SPECIAL INSTRUCTIONS

1. Modules:

MSN	B	C	TXA	TXB
1	SAT-1	SAT-2	SAT-4	-
2	SAT-2	SAT-3	SAT-5	-
3	SAT-3	SAT-4	SAT-7	-
4	SAT-4	(P) SAT-5	SAT-10	-
5	SAT-5	SAT-7	-	-
6	(P) SAT-6	(P) SAT-8	-	-
7	SAT-7	SAT-9	-	-
8	SAT-8	SAT-10	-	-
9	SAT-9	SAT-11	-	-
10	SAT-10	-	-	-
11	SAT-11	-	-	-

2. Heavyweight ordnance loads may be varied as ordnance availability dictates as long as the total weight is equivalent.

3. Empty LAUs may be carried on any SAT mission.

4. For A1000B/C students SAT-9 will be flown from a forward operating location (FOL). The mission is designed to simulate takeoff from a main base with ordnance, a heavyweight landing at a forward operating base, and subsequent FOL takeoff to accomplish the mission scenario.

5. Tactics for the applicable SAT scenario will be extracted from TACM 3-1.

6. The student must reach proficiency in low/medium threat tactics prior to familiarization training in high-threat tactics.

7. BDU-33's may be used in lieu of MK-106's until they become certified and available.

8. SAT-11 will only be flown if live ordnance is available.

9. BAM is to be practiced on SAT-4 and SAT-5. In 1:2 ratio flights the instructor chases one student while the remaining student holds above the flight. Students must be incrementally certified to 100 feet in BAM prior to training in high threat tactics. Students who cannot be certified to 100 feet in BAM will be given high threat tactics familiarization at their highest level of certification in LATN, LATF, or BAM.

10. Simulated FOL/CAS alert operations may be added to mission tasks at the option of the wing DO on SAT-5 and subsequent sorties.

LOW THREAT

SAT-1
6 BDU-33
6 MK-106
108 RND 30MM
Maverick (Captive)

Acft: 3 or 2
Time: 1.8
Ratio: 1:2

MISSION OBJECTIVE: Introduce FAC procedures, Maverick, and low-threat tactics.

MISSION TASKS: Air support low threat scenario; LATN/LATF; FAC; weapons employment; Maverick.

* * * *

SAT-2
6 BDU-33
6 MK-106
108 RND 30MM
Maverick (Captive)

Acft: 3 or 2
Time: 1.8
Ratio: 1:2

MISSION OBJECTIVE: Practice low-threat tactics with FAC.

MISSION TASKS: Air support low-threat scenario; LATN/LATF; FAC; weapons employment; Maverick.

MEDIUM THREAT

SAT-3
6 BDU-33
6 MK-106
108 RND 30MM
Maverick (Captive)

Acft: 2
Time: 1.8
Ratio: 1:1

MISSION OBJECTIVE: Introduce medium threat tactics.

MISSION TASKS. Air support medium threat scenario; LATN/LATF; RWR/PEN; weapons employment; pop-up patterns (chased); Maverick; Pave Penny; ILS approach; formation landing.

* * * *

SAT-4
6 BDU-33
6 MK-106
108 RND 30MM
Maverick (Captive)

Acft: 3 or 2
Time: 1.8
Ratio: 1:2

MISSION OBJECTIVE: Practice medium threat tactics. Introduce armed recce.

MISSION TASKS: Air support medium threat scenario; LATN/LATF; RWR/PEN; weapons employment; pop-up patterns; FAC; Maverick; BAM (jink, diamond); armed recce.

* * * *

SAT-5
6 BDU-33
6 MK-106
108 RND 30MM
Maverick (Captive)
4-2.75 RX

Acft: 3 or 2
Time: 1.8
Ratio: 1:2

MISSION OBJECTIVE: Practice medium threat tactics.

MISSION TASKS: Air support medium threat scenario; LATN/LATF; RWR/PEN; weapons employment; pop-up patterns; FAC; Maverick; BAM (jink, diamond); armed recce; minimum run landing.

* * * *

SAT-6
6 BDU-33
6 MK-106
108 RND 30MM
Maverick (Captive)

Acft: 3 or 2
Time: 1.8
Ratio: 1:2

MISSION OBJECTIVE: Practice medium threat tactics.

MISSION TASKS: Air support medium threat scenario; LATN/LATF; RWR/PEN; weapons employment; pop-up patterns; FAC (preferred); Maverick.

HIGH THREAT

SAT-7
12 MK-106
108 RND 30MM
Maverick (Captive)
4-2.75 RX

Acft: 2
Time: 1.8
Ratio: 1:1

MISSION OBJECTIVE: Introduce high threat tactics.

MISSION TASKS: Air support high threat scenario (communications jamming); LATN/LATF; RWR/PEN; weapons employment; Maverick; TACAN approach.

SAT-8 | Acft: 2
12 MK-106 | Time: 1.8
108 RND 30MM | Ratio: 1:1
Maverick (Captive)
4-2.75 RX

MISSION OBJECTIVE: Practice high threat tactics.

MISSION TASKS: Air support high threat scenario (communications jamming); LATN/LATF; RWR/PEN; weapons employment; Maverick; simulated single engine landing.

* * * *

SAT-9 | Acft: 2
10 MK-82 Snakeye | Time: 1.8
500 RND 30MM | Ratio: 1:1

MISSION OBJECTIVE: Introduce full scale weapons delivery (FSWD).

MISSION TASKS: FOL operations; air support medium to high threat scenario (communications jamming); LATN/LATF; RWR/PEN; FAC; pop-up patterns; weapons employment.

* * * *

SAT-10 | Acft: 2
1,000 RND 30MM | Time: 1.8
Maverick (Captive) | Ratio: 1:1

MISSION OBJECTIVE: Practice high threat FSWD.

MISSION TASKS: Air support high threat scenario (communications jamming); LATN/LATF; RWR/PEN; weapons employment; Maverick; formation landing.

* * * *

SAT-11 | Acft: 2
4 MK-82 Snakeye (Live) | Time: 1.8
Maverick (Captive) | Ratio: 1:1
216 RND 30MM
8-2.75 RX

MISSION OBJECTIVE: Introduce live ordnance deliveries.

MISSION TASKS: Interdiction scenario; LATN/LATF; FAC (desired); RWR/PEN; pop-up patterns; weapons employment; Maverick; simulated single engine landing.

SPECIAL INSTRUCTIONS

1. Modules:

MSN	B	C	TXA	TXB
1	NCV	NCV	NCV	NCV
2	NSAAR	NSAAR	NSAAR	-

2. Aircraft loaded with the SUU-25 flare dispenser will not make formation takeoffs or intentional low approaches.

3. Ordnance checks will not be made on night range missions.

4. The range officer has the primary responsibility for calling out dud flares. Individual flight members will assist in calling out the location of duds. The range officer will cease operations any time he considers duds or burned out flares to be a hazard. The flaring aircraft will call out the number of flares released as an aid in determining flare status.

5. The air refueling portion of Surface Attack Special Instructions applies to NSAAR.

6. Night Surface Attack is scheduled to provide familiarization in night gunnery. If circumstances dictate, only the air refueling portion of the mission needs to be flown for an effective mission.

NCV
Clean

Acft: 2
Time: 1.5
Ratio: 1:1

MISSION OBJECTIVE: Introduce night formation and normal overhead patterns.

MISSION TASKS: Wing formation takeoff; route/close formation; pitchouts/rejoins; instrument recovery and approach; normal overhead patterns and landing.

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NSAAR
6 BDU-33
108 RND 30MM
8 Flares

Acft: 4, 3, or 2
Time: 2.7
Ratio: 1:3

MISSION OBJECTIVE: Introduce night air refueling.

MISSION TASKS: Air refueling; flare carriage and delivery; DB; LALD; LAB; 30MM LAS; landing from instrument approach.

AIR COMBAT TRAINING

SPECIAL INSTRUCTIONS

1. Modules:

MSN	B	C	TXA/TXB
1	DCM	DCM	-
2	DDCM	DDCM	-
3	DACT	DACT	-
4	DACT/SAT	DACT/SAT	-

2. The ACT phase is a stair-step phase to lead the student into the air-to-air environment. A dissimilar aircraft will employ Soviet air-to-air tactics against A-10 defensive formations.

3. Five thousand feet AGL is the minimum altitude during ACT/DACT.

4. Gun cameras will be used if the gun safety pin is installed.

5. All DDCM/DACT briefings and debriefings will be in accordance with TACR 51-2.

6. Rules of Engagement will be in accordance with TACR 55-110 and the appropriate 55-series manual of the dissimilar aircraft.

7. Defensive tactics will be in accordance with TACM 3-1.

DCM
Clean

Acft: 4
Time: 1.8
Ratio: 2:2

MISSION OBJECTIVE: Introduce DCM.

MISSION TASKS: LATF; tactical formation; defensive combat maneuvers (2V2); minimum run landing.

* * * *

DDCM
Clean

Acft: 2
1 Dissimilar
Time: 1.8
Ratio: 1:1

MISSION OBJECTIVE: Introduce DDCM.

MISSION TASKS: LATF; dissimilar defensive combat maneuvers (2V1); TACAN penetration and approach.

* * * *

DACT
Clean

Acft: 2
2 Dissimilar
Time: 1.8
Ratio: 1:1

MISSION OBJECTIVE: Practice DACT.

MISSION TASKS: LATF; dissimilar air combat tactics (2V2); GCA/ILS pattern and approach.

* * * *

DACT/SAT
4 MK-82 Snakeye (Inert)
Maverick (Captive)

Acft: 2
2 Dissimilar
Time: 1.8
Ratio: 1:1

MISSION OBJECTIVE: Practice DACT and SAT mission with more than one aggressor.

MISSION TASKS: LATF; dissimilar air combat tactics (2V2); interdiction scenario; pop-up patterns; Maverick.

COURSE OBJECTIVES CHART

SPECIAL INSTRUCTIONS

1. The Course Objectives Chart denotes when the student, by sortie and objective, should reach the 1, 2, or 3 levels of performance. The placement of these performance levels is based on opportunity to practice the objective and on anticipated/desired student progress. Therefore, these performance levels (excluding CRS STD column) should be treated as minimum desired performance levels for a given amount of training devoted to the objective.

2. The Course Standard (CRS STD) column shows the minimum required performance level necessary to qualify for course graduation. The point where the desired performance level corresponds with the required performance level is the point where the student must meet or exceed the designated performance level. If the student does not meet the designated performance level at the proper sortie, he will be assigned a grade of 0 for that objective. EXCEPTIONS:

LATN (300' AGL) LATN (100' AGL) LATF (300' AGL)	A grade of 1 is acceptable for these objectives if the student is unable to meet the desired 2 or 3 performance levels. However, a student must meet the desired performance level in order to proficiency advance. (See General Instructions/4.)

Atch 1

A1000B COURSE OBJECTIVES CHART

	CV1B	CV2B	CV3B	CV4B	CV5B	CV6B	IQ	BAM1	BAM2	BAM3	SA1	SA2	SAAR3	SA4	SA5	SA6	SAT1	SAT2	SA7	SAAR8	SA9	SA10	NCV	NSAAR	SAT3	SAT4	SAT5	SAT6	SAT7	SAT8	SAT9	SAT10	DCM	DDCM	DACT	DACT SAT	SAT11	CRS STD
						(P)				(P)				(P)	(P)						(P)							(P)										
Mission Planning	2		3																																			2
Pretakeoff	1		2			3																																2
Takeoff (Single-Ship)	1		2			3																																2
Takeoff (Wing)				1	2						3																											2
IFR Departure/Climb	1		2			3																																2
Level Off	1		2			3																																2
Cruise/Nav	1		2			3																																2
Low Level Nav (500' AGL)								1	2	3																												2
LATN (500' AGL)											1	2		3																								2
LATN (300' AGL)													1			2					3																	1
LATN (100' AGL)															1										2			3										1
Formation																																						
Route	1		2			3																																2
Close	1			2		3																																2
Fighting Wing			1		2	3																																2
Close Trail				1	2	3																																2
Pitchouts/Rejoins			1	2		3																																2
Tactical								1		2																												2
LATF (500' AGL)													1				2				3																	2
LATF (300' AGL)															1											2		3										1
LATF (100' AGL)															1																							1
Joinup/Rejoin								2			3																											2
Airwork																																						
Stall Recoveries	2					3																																2
BAM																																						
Turn Radius			1		2	3																																2
30° Dive			1		2	3																																2
20° Dive			1		2	3																																2
Pop-up								1	2	3																												2
Jink								1		2																	3											2
Diamond								1		2																	3											2
Confidence Maneuver				2																																		2
BFM																																						
L/D Turns								1	2	3																												2
Hard Turns								1	2	3																												2
Breaks								1	2	3																												2
Yo-Yo's								1	2	3																												2
Reversals								1	2	3																												2
DCM																																	2					2
ACT																																			2			2
Air Refueling													1							2																		2

A1000B

A1000B COURSE OBJECTIVES CHART

	CV1B	CV2B	CV3B	CV4B	CV5B	CV6B (P)	TQ	BAM1	BAM2	BAM3 (P)	SA1	SA2	SAR3	SA4 (P)	SA5 (P)	SA6	SAT1	SAT2	SA7	SAR8	SA9 (P)	SA10	NCV	NSAR	SAT3	SAT4	SAT5	SAT6 (P)	SAT7	SAT8	SAT9	SAT10	DCM	DDCM	DACT	DACTSAT	SAT11	CRS STD
Wpns Systems Checks											1	2		3																								2
Wpns Employ (Norm/Hvy)																																						
DB											1			2								3																2
LALD											1			2								3																2
LAB											1			2								3																2
LAB - Level												1																										1
LAS (5-15°)											1			2							3																	2
RX												1																										1
HAS/Pave Penny													1																									1
LALD (Pop-up)																			1		2							3										2
LAB (Pop-up)																			1		2							3										2
LAS (Pop-up)																			1	2	3																	2
LRS																			1		2											3						2
LAS (0-5°)																					1																	1
TTS																						1																1
Flare																								1														1
Ord Delivery Recovery											2	3																										2
Surface Attack Tac																																						
Low Threat																	1	2																				2
With FAC																	1	2										3										2
Maverick																	1																					1
Pave Penny													1																									1
Medium Threat																									1		2	3										2
Armed Recce																										1												1
High Threat																													1									1
FOL Operations																															1							1
Target Acquisition											1		2														3											2
RWR/PEN																										1			2	3								2
Comm/IFF-SIF	1		2			3																																2
Inflight Checks	1		2			3																																2
Steep Turns			1	2		3																																2
Descent	1		2			3																																2
Holding		1			2	3																																2
Inst Pen & Approach		1			2	3																																2
Non-Precision App																																						
TACAN		1			2	3																																2
ASR	2					3																																2
Missed Approach	2					3																																2
Instrument Pattern	2					3																																2
Precision Approach																																						
PAR	2					3																																2
ILS				1	2	3																																2

A1000B COURSE OBJECTIVES CHART

	CV1/B	CV2/B	CV3/B	CV4/B	CV5/B	CV6/B	IQ	BAM1	BAM2	BAM3	SA1	SA2	SAAR3	SA4	SA5	SA6	SAT1	SAT2	SA7	SAAR8	SA9	SA10	NCV	NSAAR	SAT3	SAT4	SAT5	SAT6	SAT7	SAT8	SAT9	SAT10	DCM	DDCM	DACT	DACT/SAT	SAT11	CRS STD
						(P)				(P)				(P)	(P)						(P)							(P)										
VFR Traffic Pattern		1	2			3																																2
VFR Approaches																																						
Normal		1		2		3																																2
No-flap		1		2		3																																2
Sim Single Engine			1	2		3																																2
Go-around/Closed		1	2			3																																2
Landing																																						
Normal		1	2			3																																2
Sim Single Engine																						1								2								2
Minimum Run																				1							2						3					2
Form App & Landing					1			2																								3						2
After Landing	1		2			3																																2
Systems Ops (Normal/ Emerg)	3																																					3

A1000B

A1000C COURSE OBJECTIVES CHART

	CV1T	CV2T	CV3T	CV5B	CV6B	IQ	BAM1	BAM2	BAM3	SA1	SA2	SAR3	SA4	SA5	SA6	SA7	SAR8	SA9	SA10	NCV	NSAAR	SAT2	SAT3	SAT4	SAT5	SAT7	SAT8	SAT9	SAT10	DCM	DDCM	DACT	DACT SAT	SAT11	CRS STD
					(P)				(P)				(P)	(P)				(P)							(P)		(P)								
Mission Planning	2		3																																2
Pretakeoff	1		2		3																														2
Takeoff (Single-Ship)	1	2			3																														2
Takeoff (Wing)			1	2						3																									2
IFR Departure/Climb	1		2		3																														2
Level Off	1		2		3																														2
Cruise/Nav	1		2		3																														2
Low Level Nav (500' AGL)							1	2	3																										2
LATN (500' AGL)										1	2		3																						2
LATN (300' AGL)												1			2			3																	1
LATN (100' AGL)														1									2		3										1
Formation																																			
Route	1		2		3																														2
Close	1		2		3																														2
Fighting Wing			1	2	3																														2
Close Trail			1	2	3																														2
Pitchouts/Rejoins		1		2	3																														2
Tactical							1		2																										2
LATF (500' AGL)												1			2			3																	2
LATF (300' AGL)														1					2					3											1
LATF (100' AGL)														1																					1
Joinup/Rejoin							2			3																									2
Airwork																																			
Stall Recoveries	2				3																														2
BAM																																			
Turn Radius		1		2	3																														2
30^o Dive		1		2	3																														2
20^o Dive		1		2	3																														2
Pop-up							1	2	3																										2
Jink							1		2																3										2
Diamond							1		2																3										2
Confidence Maneuver				2																															2
BFM																																			
L/D Turns							1	2	3																										2
Hard Turns							1	2	3																										2
Breaks							1	2	3																										2
Yo-Yo's							1	2	3																										2
Reversals							1	2	3																										2
DCM																														2					2
ACT																																2			2
Air Refueling												1					2																		2

A1000C

A1000C COURSE OBJECTIVES CHART

	CV1T	CV2T	CV3T	CV5B	CV6B	IQ	BAM1	BAM2	BAM3	SA1	SA2	SAR3	SA4	SA5	SA6	SA7	SAR8	SA9	SA10	NCV	NSAAR	SAT2	SAT3	SAT4	SAT5	SAT7	SAT8	SAT9	SAT10	DCM	DDCM	DACT	DACT/SAT	SAT11	CRS STD
					(P)				(P)				(P)	(P)				(P)							(P)		(F)								
Weapons Systems Checks										1	2		3																						2
Weapons Employ (Normal/Heavy)																																			
DB										1			2						3																2
LALD										1			2						3																2
LAB										1			2						3																2
LAB - Level											1																								1
LAS (5-15°)										1			2					3																	2
RX											1																								1
HAS/Pave Penny												1																							1
LALD (Pop-up)																1		2							3										2
LAB (Pop-up)																1		2							3										2
LAS (Pop-up)																1	2	3																	2
LRS																1		2											3						2
LAS (0-5°)																		1																	1
TTS																			1																1
Flare																					1														1
Ordnance Delivery Recovery										2	3																								2
Surface Attack Tactics																																			
Low Threat																						2													2
With FAC																						1		2	3										2
Maverick																						1													1
Pave Penny												1																							1
Medium Threat																							1	2	3										2
Armed Recce																								1											1
High Threat																										1	2								1
FOL Operations																												1							1
Target Acquisition										1		2													3										2
RWR/PEN																								1		2		3							2
Comm/IFF-SIF	1	2			3																														2
Inflight Checks	1	2			3																														2
Steep Turns		1	2		3																														2
Descent	1	2			3																														2
Holding		1	2		3																														2
Inst Penetration & Approach		1	2		3																														2
Non-Precision Approach																																			
TACAN		1	2		3																														2
ASP	1		2		3																														2
Missed Approach	1	2			3																														2
Instrument Pattern	1		2		3																														2
Precision Approach																																			
PAR	1		2	3																															2
ILS			1	2	3																														2

A1000C

A1000C COURSE OBJECTIVES CHART

	CV1/T	CV2/T	CV3/T	CV5/B	CV6/B	IQ	BAM1	BAM2	BAM3	SA1	SA2	SAAR3	SA4	SA5	SA6	SA7	SAAR8	SA9	SA10	NCV	NSAAR	SAT2	SAT3	SAT4	SAT5	SAT7	SAT8	SAT9	SAT10	DCM	DDCM	DACT	DACT/SAT	SAT11	CRS STD
					(P)				(P)				(P)	(P)				(P)							(P)		(P)								
VFR Traffic Pattern	1	2			3																														2
VFR Approaches																																			
Normal	1	2			3																														2
No-flap		1	2		3																														2
Simulated Single Engine		1	2		3																														2
Go-around/Closed	1	2			3																														2
Landing																																			
Normal	1	2			3																														2
Simulated Single Engine																			1								2								2
Minimum Run																	1								2					3					2
Form App & Landing				1			2																						3						2
After Landing	1		2		3																														2
Systems Operations (Normal/ Emergency)	3																																		3

A1000C

A1000TXA COURSE OBJECTIVES CHART

	CV1T	CV2T	CV3T	CV4T	CV5T (P)	IQ	SA1	SA2	SAAR3	SA4 (P)	SA7	SA10	NCV	NSAAR	SAT4	SAT5	SAT7	SAT10	CRS STD
Mission Planning	2		3																2
Pretakeoff	1		2		3														2
Takeoff (Single-Ship)	1	2			3														2
Takeoff (Wing)			1	2			3												2
IFR Departure/Climb	1		2		3														2
Level Off	1		2		3														2
Cruise/Nav	1		2		3														2
Low Level Nav (500' AGL)							2												2
LATN (500' AGL)							1	2		3									2
LATN (300' AGL)								1	2	3									1
LATN (100' AGL)									1			2					3		1
Formation																			
Route	1		2		3														2
Close	1		2		3														2
Fighting Wing			1	2	3														2
Close Trail			2		3														2
Pitchouts/Rejoins		1	2		3														2
Tactical				2															2
LATF (500' AGL)								1			2				3				2
LATF (300' AGL)									1			2				3			1
LATF (100' AGL)											1								1
Joinup/Rejoin				2			3												2
Airwork																			
Stall Recoveries	2				3														2
BAM																			
Turn Radius		2																	2
30^{o} Dive		1	2		3														2
20^{o} Dive		1	2		3														2
Pop-up			1	2	3														2
Jink															2	3			2
Diamond															2	3			2
Confidence Maneuver				2															2
BFM																			
L/D Turns				2	3														2
Hard Turns				2	3														2
Breaks				2	3														2
Yo-Yo's				2	3														2
Reversals				2	3														2
Air Refueling									2										2
Weapons Systems Checks							1	2		3									2

A1000TXA

A1000TXA COURSE OBJECTIVES CHART

	CV1T	CV2T	CV3T	CV4T	CV5T (P)	IQ	SA1	SA2	SAAR3	SA4 (P)	SA7	SA10	NCV	NSAAR	SAT4	SAT5	SAT7	SAT10	CRS STD
Weapons Employment (Normal/Heavy)																			
DB							1			2		3							2
LALD							1			2		3							2
LAB							1			2		3							2
LAB - Level								1											1
LAS (5-15°)							1			2	3								2
RX								1											1
HAS/Pave Penny									1										1
LALD (Pop-up)											1	2				3			2
LAB (Pop-up)											1	2				3			2
LAS (Pop-up)											1				2	3			2
LRS											1								1
LAS (0-5°)												1							1
TTS												1							1
Flare														1					1
Ordnance Delivery Recovery							2	3											2
Surface Attack Tactics																			
With FAC															2	3			2
Maverick															1				1
Medium Threat															1	2			2
Armed Recce															1				1
High Threat															1				1
Target Acquisition							2	3											2
RWR/PEN															1		2		2
Comm/IFF-SIF	1	2			3														2
Inflight Checks	1	2			3														2
Steep Turns		1	2		3														2
Descent	1	2			3														2
Holding		1	2		3														2
Instrument Penetration & Approach		1	2		3														2
Non-Precision Approach																			
TACAN		1	2		3														2
ASR	1	2			3														2
Missed Approach	1	2			3														2
Instrument Pattern	1	2			3														2
Precision Approach																			
PAR	1		2		3														2
ILS			1	2	3														2
VFR Traffic Pattern	1	2			3														2

A1000TXA

A1000TXA COURSE OBJECTIVES CHART

	CV1T	CV2T	CV3T	CV4T	CV5T (P)	IQ	SA1	SA2	SAAR3	SA4 (P)	SA7	SA10	NCV	NSAAR	SAT4	SAT5	SAT7	SAT10	CRS STD
VFR Approaches																			
Normal	1	2			3														2
No-flap		1	2		3														2
Simulated Single Engine		1	2		3														2
Go-around/Closed	1	2			3														2
Landing																			
Normal	1	2			3														2
Simulated Single Engine												1							1
Minimum Run																1			1
Form App & Landing				1				2											2
After Landing	1		2		3														2
Systems Operations (Normal/Emerg)	3																		3

A1000TXA

A1000TXB COURSE OBJECTIVES CHART

	CV1T	CV2T	CV3T	CV4T	CV5T (P)	IQ	NCV	CRS STD
Mission Planning	2		3					2
Pretakeoff	1		2		3			2
Takeoff (Single-Ship)	1	2			3			2
Takeoff (Wing)			1	2				2
IFR Departure/Climb	1		2		3			2
Level Off	1		2		3			2
Cruise/Nav	1		2		3			2
Formation								
Route	1		2		3			2
Close	1		2		3			2
Fighting Wing			1	2	3			2
Close Trail			2		3			2
Pitchouts/Rejoins		1	2		3			2
Tactical				2				2
Joinup/Rejoin				2				2
Airwork								
Stall Recoveries	2				3			2
BAM								
Turn Radius		2						2
30° Dive		1	2		3			2
20° Dive		1	2		3			2
Pop-up			1	2	3			2
Confidence Maneuver				2				2
BFM								
L/D Turns				2	3			2
Hard Turns				2	3			2
Breaks				2	3			2
Yo-Yo's				2	3			2
Reversals				2	3			2
Comm/IFF-SIF	1	2			3			2
Inflight Checks	1	2			3			2
Steep Turns		1	2		3			2
Descent	1	2			3			2
Holding		1	2		3			2
Instrument Penetration & Approach		1	2		3			2
Non-Precision Approach								
TACAN		1	2		3			2
ASR	1	2			3			2
Missed Approach	1	2			3			2
Instrument Pattern	1	2			3			2

A1000TXB

A1000TXB COURSE OBJECTIVES CHART

	CV1T	CV2T	CV3T	CV4T	CV5T (P)	IQ	NCV	CRS STD
Precision Approach								
PAR	1		2		3			2
ILS			1	2	3			2
VFR Traffic Pattern	1	2			3			2
VFR Approaches								
Normal	1	2			3			2
No-flap		1	2		3			2
Simulated Single Engine		1	2		3			2
Go-around/Closed	1	2			3			2
Landing								
Normal	1	2			3			2
Formation Approach & Landing				1				1
After Landing	1		2		3			2
Systems Operations (Normal/Emerg)	3							3

A1000TXB

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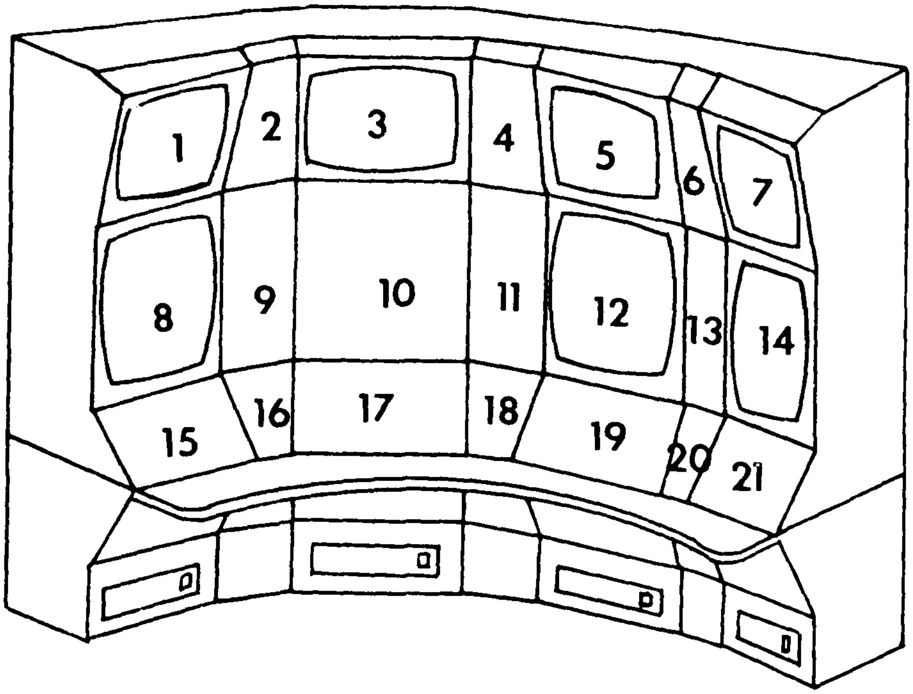
APPENDIX B: A-10 IOS PANEL CONFIGURATIONS, FUNCTIONS, AND OPERATION



Panel No.	Figure No.	Panel No.	Figure No.
1	B-8	12	B-10
2	B-6	13	B-32
3	B-9	14	B-10
4	B-7	15	B-28
5	B-8	16	B-29
6	B-31	17	B-3
7	B-10	18	B-30
8	B-10	19	B-27
9	B-4	20	B-33
10	B-2	21	B-34
11	B-5	Graphic CRT Pages	B-11 to B-26

Figure B-1. **Proposed A-10 instructor/operator station panel enumeration.**

Table B-1. IOS Panel No. 10. Functions

Control/Display	Function
ATTITUDE Indicator	Repeats the cockpit instrument indications.
HEADING Indicator	Repeats the cockpit instrument indications.
CLIMB Indicator	Repeats the cockpit instrument indications.
ALTITUDE Indicator	Repeats the cockpit instrument indications.
TV (classified)	Repeats the cockpit instrument indications.
ENGINE Instruments	Repeats the cockpit instrument indications.
AIRSPEED Indicator	Repeats the cockpit instrument indications.
STANDBY Attitude Ind.	Repeats the cockpit instrument indications.
ANGLE OF ATTACK Indicator	Repeats the cockpit instrument indications.
CLOCK	Repeats the cockpit instrument indications.
MASTER CAUTION Indicator	Repeats the cockpit instrument indications.
MARKER BEACON Indicator	Repeats the cockpit instrument indications.
UNLOCKED CANOPY Indicator	Repeats the cockpit instrument indications.
HUD Status Indicator	Indicates which HUD mode is selected.
ARMAMENT CONTROL PANEL	Indicates active armament control functions.
EXT STRS JETT Indicator	Indicates jettison switch is actuated.
L ENG FIRE Indicator	Indicates when fire handle is pulled.
APU FIRE Indicator	Indicates when fire handle is pulled.
R ENG FIRE Indicator	Indicates when fire handle is pulled.
NAV MODE Indicators	Indicates which navigation mode is selected.

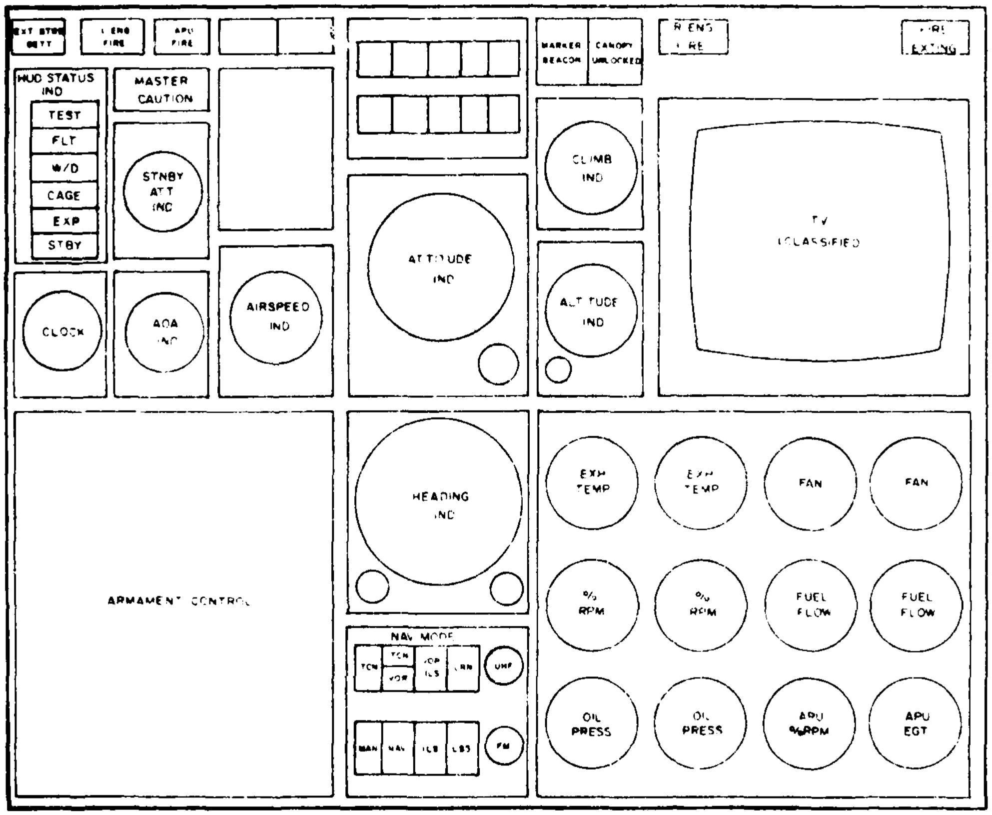


Figure B-2. IOS panel no. 10, primary flight instruments.

Table B-2. IOS Panel No. 17. Functions

Control/Display	Function
SPEED BRAKE Indicator	Repeats the cockpit instrument indications.
IN, OUT	Indicates position of the speed brake switch.
FLAP Indicator	Repeats the cockpit instrument indications.
UP, 1/2, DOWN	Indicates position of cockpit flaps handle.
LANDING GEAR Indicators	
LEVER (UP, DOWN)	Indicate position of cockpit landing gear handle.
DOWN & LOCKED (L,F,R)	Indicate the respective landing gear are down and locked.
NWS ON	Indicates when cockpit nose wheel steering button is activated.
L TOE BRK, R TOE BRK	Indicate that respective toe brakes have been deflected.
STALL WARN Indicator	Indicates that aircraft is in a stall condition.
DME readout	Indicates distance in nautical miles from selected TACAN station.
LIGHTS (Exterior)	
ANTI COLSN	Indicates anti collision beacon switch is in on position.
LDG, TAXI	Indicates position of landing/taxi lights switch.
TISL Indicators	Indicates active Target Identification Set Laser (TISL) functions. Specific indicators have not been defined.

Table B-2 (*Continued*)

Control/Display	Function
FLIGHT CONTROLS (Formation Flight)	
THROTTLES	Enables IP to control throttle when flying as lead aircraft in formation flight mode.
CONTROL STICK	Enables IP to control aircraft flight when flying as lead in formation flight mode.
FORMATION FLIGHT ON	Activates the formation flying program. Automatically sets simulated IOS controlled aircraft as the lead aircraft and cockpit as wing aircraft.
WING IOS	Sets IOS controlled aircraft as wing aircraft.
HYDRAULIC PRESSURE (HYD) Indicators	Repeats the cockpit instrument indications.
FUEL QUANTITY and GROSS WEIGHT Indicator	Repeats the cockpit instrument indications.
FUEL QUANTITY SELECTOR	Indicates the position of the cockpit selector.

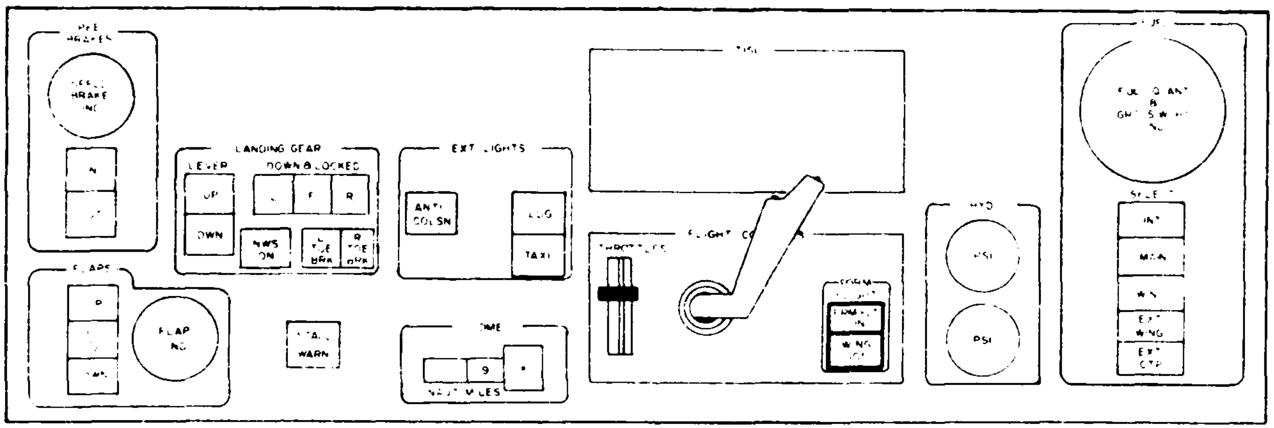


Figure B-3. IOS panel no. 17, primary flight instruments.

Table B-3. IOS Panel No. 9. Functions

Control/Display	Function
FUEL SYSTEM CONTROL Panel	
EMERGENCY FLIGHT CONTROL Panel	
STABILITY AUGMENTATION SYSTEM Panel	
IFF CONTROL Panel	
ANTENNA SELECT Panel	The control and display functions associated with these panels were not used by the IPs nor were they specified as requirements for A-10 flight training. However, to provide a full-fidelity, full-mission capability, space was reserved for these functions. The specific controls and displays used in the panel should be defined by the using command.
INTERCOM CONTROL Panel	
UHF Radio Control Panel	
VHF/AM Control Panel	
VHF/FM Control Panel	
AUXILIARY LIGHTING CONTROL Panel	
TV Monitor (Classified) Control Panel	
HF/VHF Control Panel	
SEAT POSITION Control Panel	
IGNITION Control Panel	
ENGINE Control Panel	
THROTTLE POSITION Indicators	Indicate left and right throttle settings.

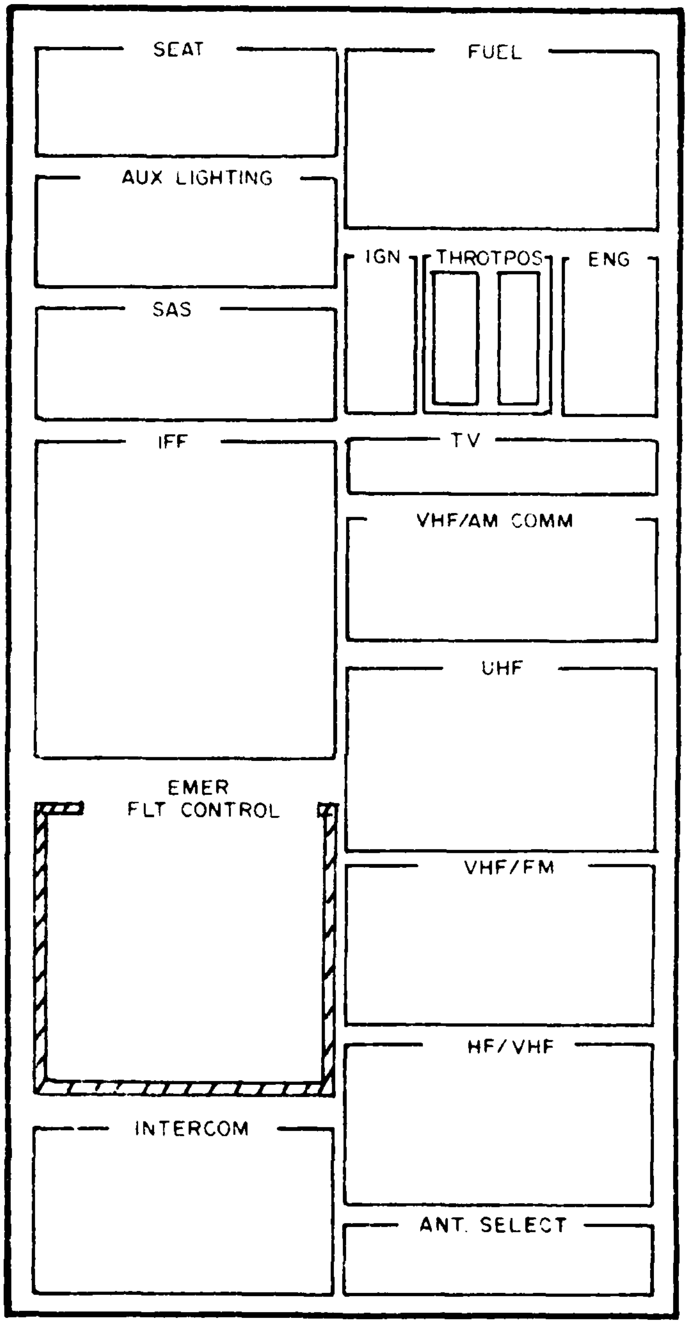


Figure B-4. IOS panel no. 9, left A/C console flight instruments.

Table B-1. IOS Panel No. 11, Functions

<table>
<tr><th>Control/Display</th><th>Function</th></tr>
<tr><td>ELECTRICAL POWER Panel</td><td rowspan="11">The control and display functions associated with these panels were not used by the IPs nor were they specified as requirements for A-10 flight training. However, to provide a full-fidelity, full-mission training capability, space was reserved for these functions. The specific controls and displays used in the panels should be defined by the using command.</td></tr>
<tr><td>HEADING ATTITUDE REFERENCE SYSTEM Panel</td></tr>
<tr><td>TACAN Control Panel</td></tr>
<tr><td>CANOPY Control Panel</td></tr>
<tr><td>ENVIRONMENT Control Panel</td></tr>
<tr><td>LIGHTING Control Panel</td></tr>
<tr><td>OXYGEN Panel</td></tr>
<tr><td>ELECTRONIC COUNTERMEASURES Control Panel</td></tr>
<tr><td>CAUTION ANNUNCIATOR Panel</td></tr>
<tr><td>CHAFF/FLARE Control Panel</td></tr>
<tr><td>LORAN Control Panel</td></tr>
</table>

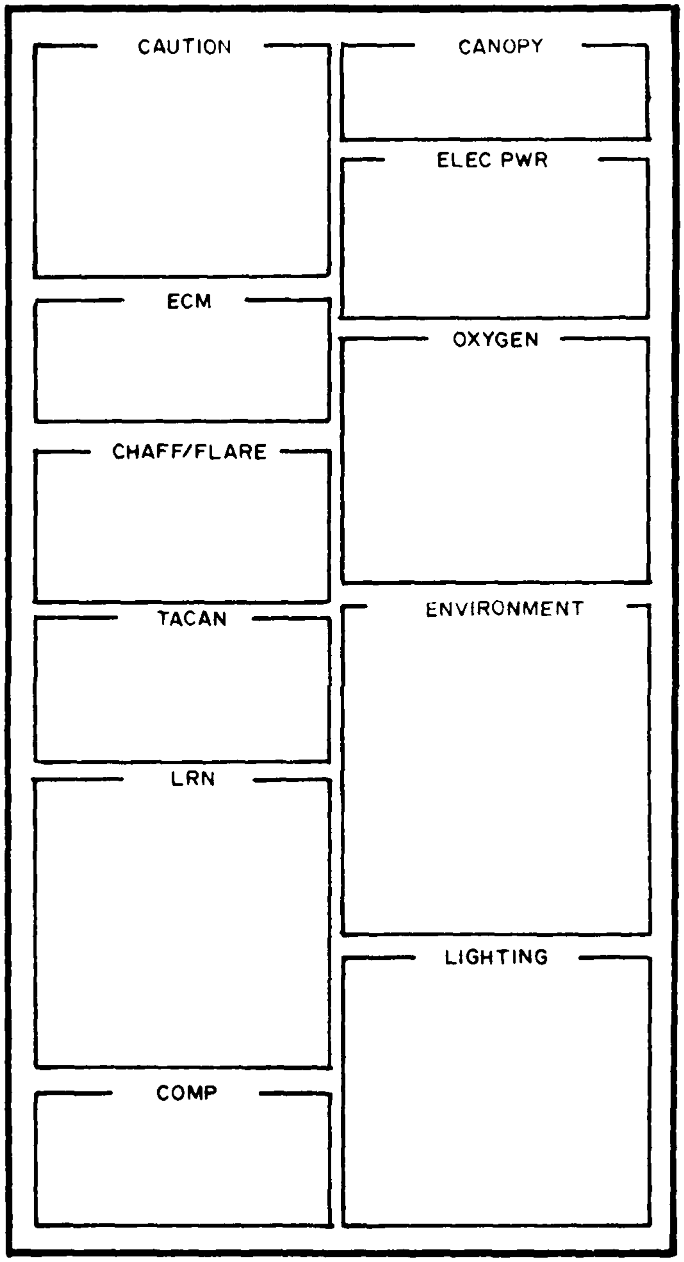


Figure B-5. IOS panel no. 11, right A/C console flight instruments.

Table B-5. IOS Panel No. 2, Functions

Control/Display	Function
ACCELERATION (g-force) Indicator	Repeats the cockpit instrument indications.
ANGLE OF ATTACK INDEXER	Repeats the cockpit instrument indications.
VIDEO CHANNEL SELECT	Enables IP to select any video channel for display on left CRT monitor.
CCTV ON	Left CRT Monitor functions as CCTV when switch is activated.

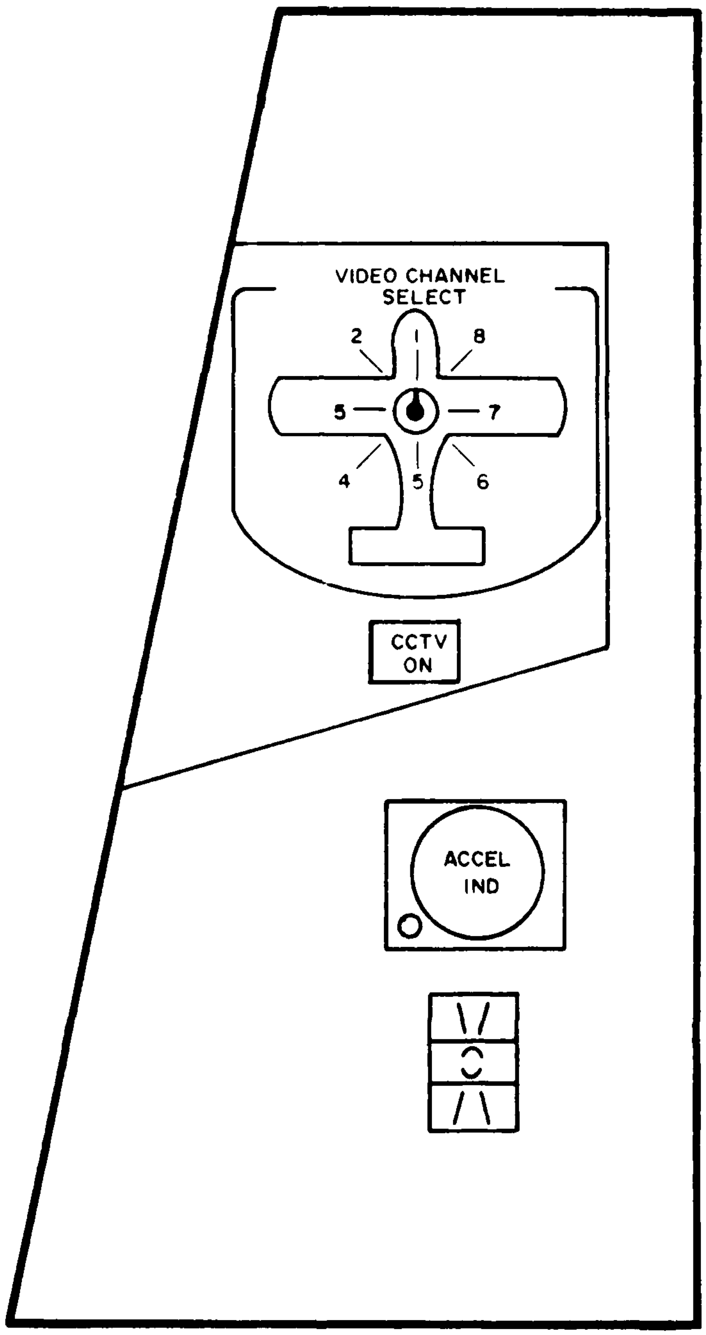


Figure B-6. IOS panel no. 2, flight instruments and left CRT monitor controls.

Table B-6. IOS Panel No. 4. Functions

Control/Display	Function
COMPASS	Repeats the cockpit instrument indications.
CANOPY STATUS Lights (READY, LATCHED, DISCONNECT)	Repeats the cockpit instrument indications.
VIDEO CHANNEL SELECT	Enables IP to select any video channel for display on right CRT monitor.
CCTV ON	Right CRT monitor functions as CCTV when switch is activated.

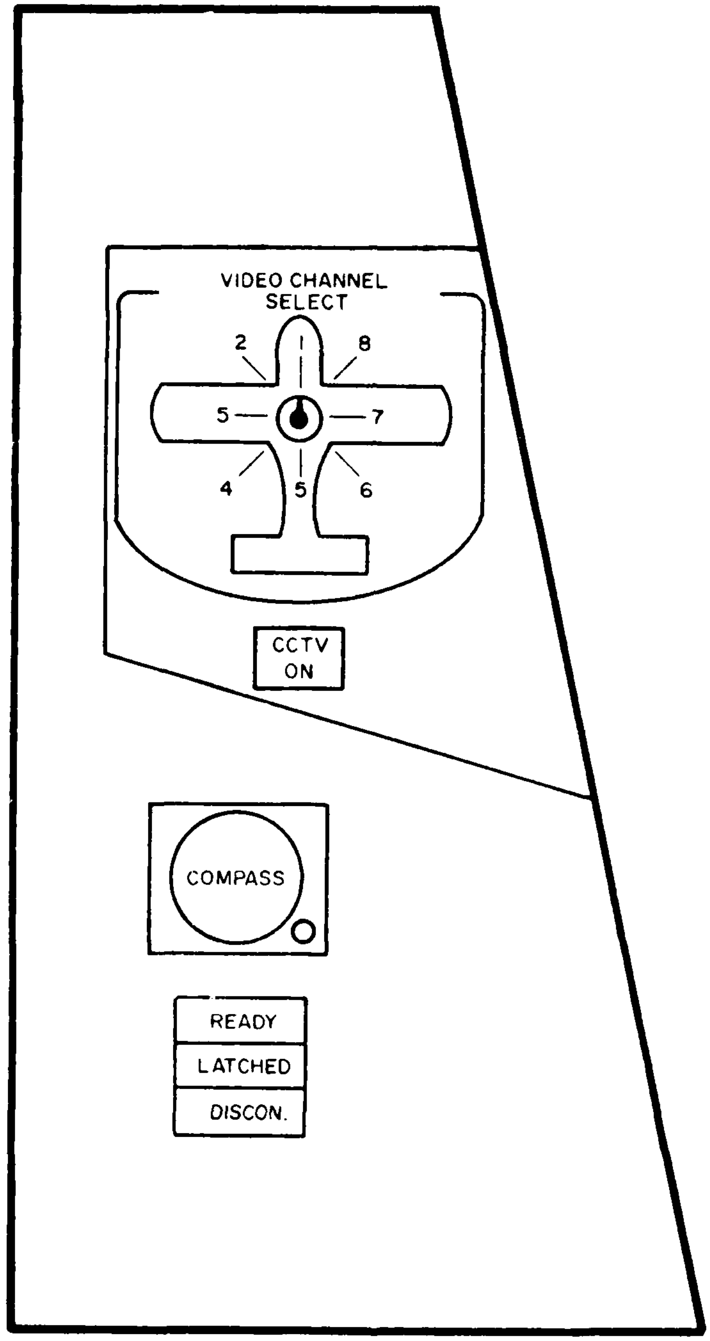


Figure B-7. IOS panel no. 4, flight instruments and right CRT monitor controls.

Table B-7. IOS Panels Nos. 1 and 5, Functions

Control/Display	Function
VIDEO MONITORS or CCTV	Displays the selected channel of the cockpit visual scene or it can be used as a CCTV monitor.

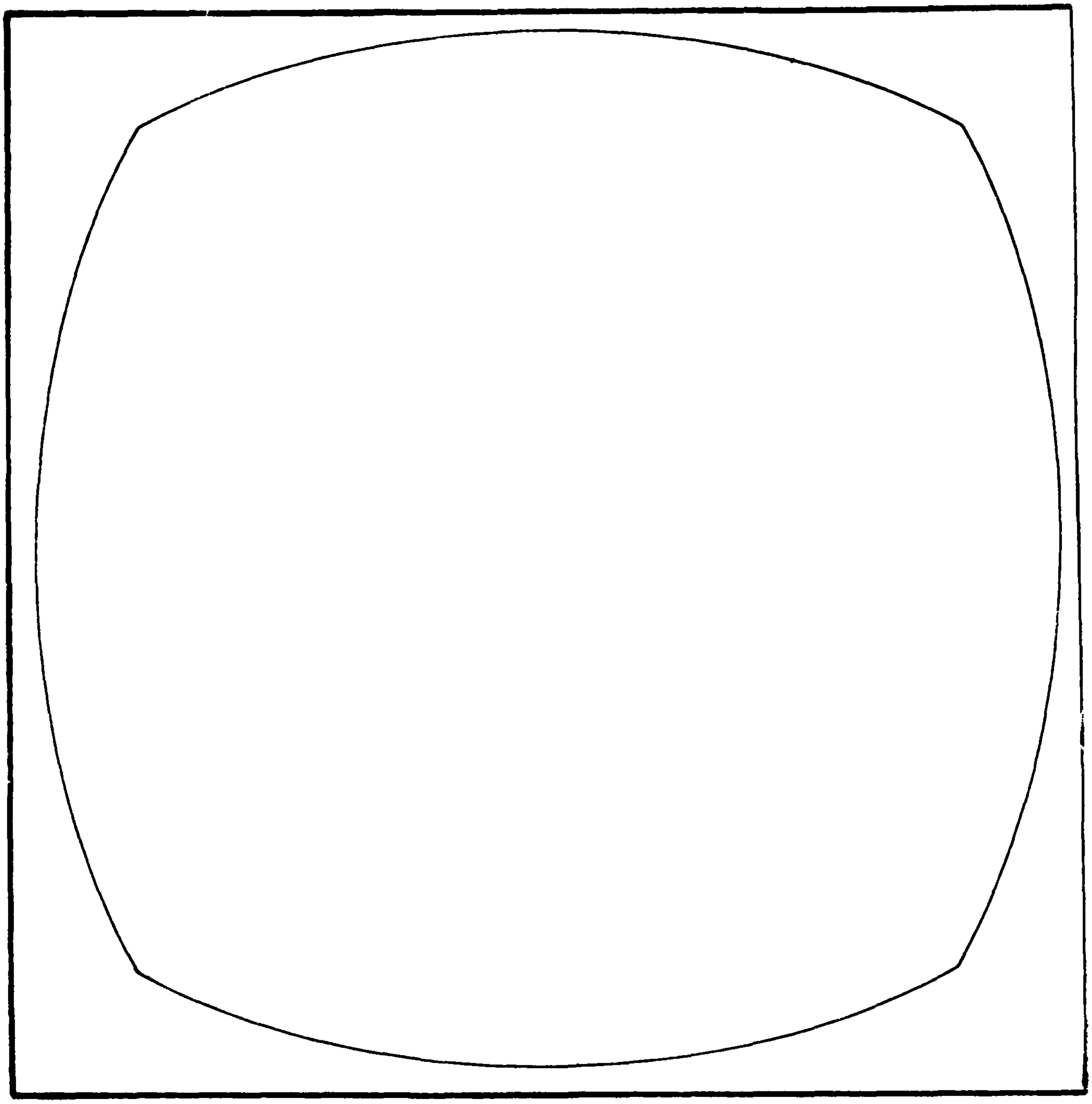


Figure B-8. IOS panels 4 and 5, video monitors or closed circuit television.

Table B-8. IOS Panel No. 3, Functions

Control/Display	Function
HUD and Forward View Video Monitor	Displays the cockpit forward view visual scene and provides a superimposed head-up display (HUD) that repeats the cockpit HUD symbology and dynamics.

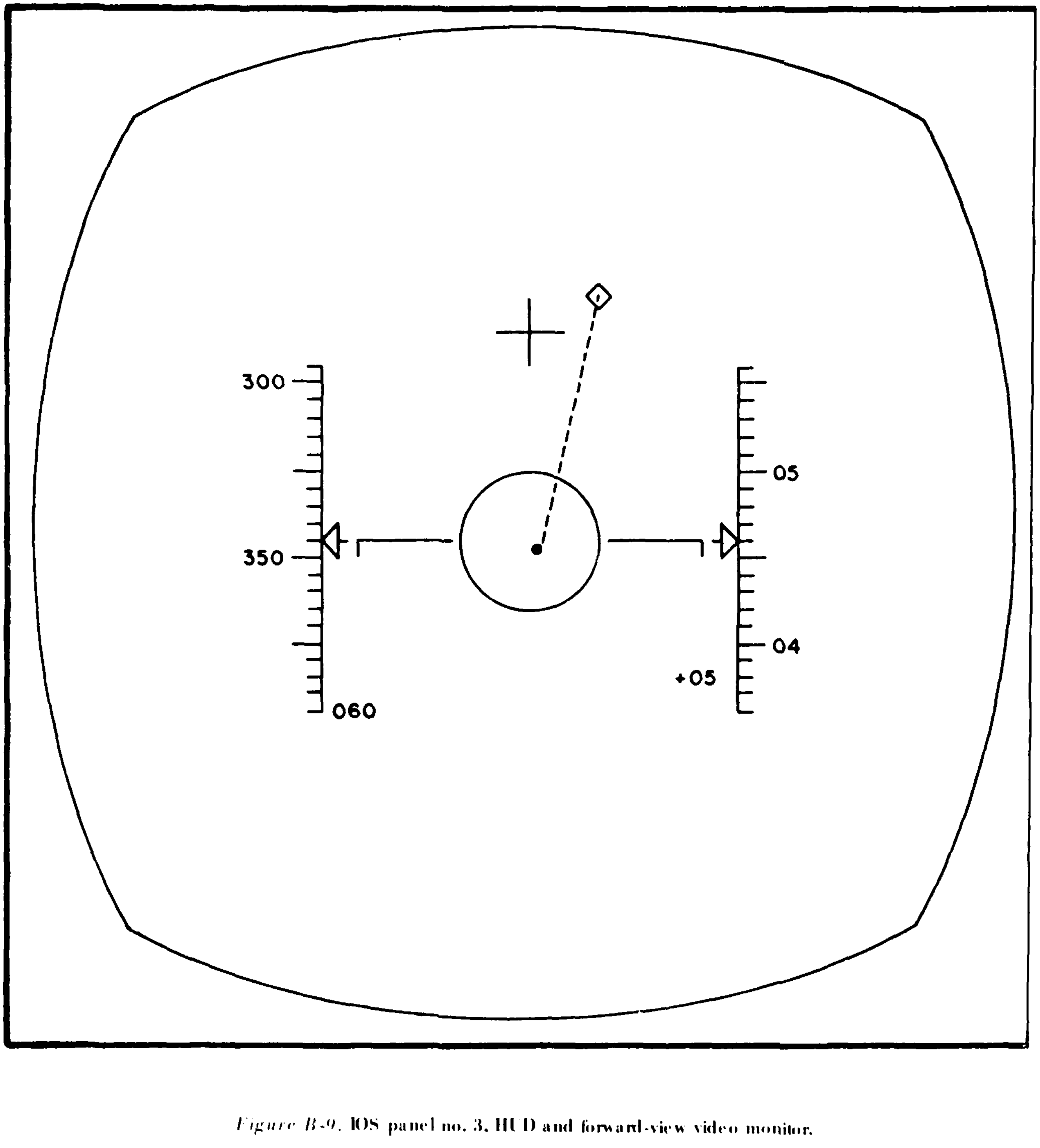


Figure B-9. IOS panel no. 3, HUD and forward-view video monitor.

Table B-9. **IOS Panels 7, 8, 12, and 14, Functions**

Control/Display	Function
Graphic CRTs	Displays the graphic CRT pages as selected by the IP.

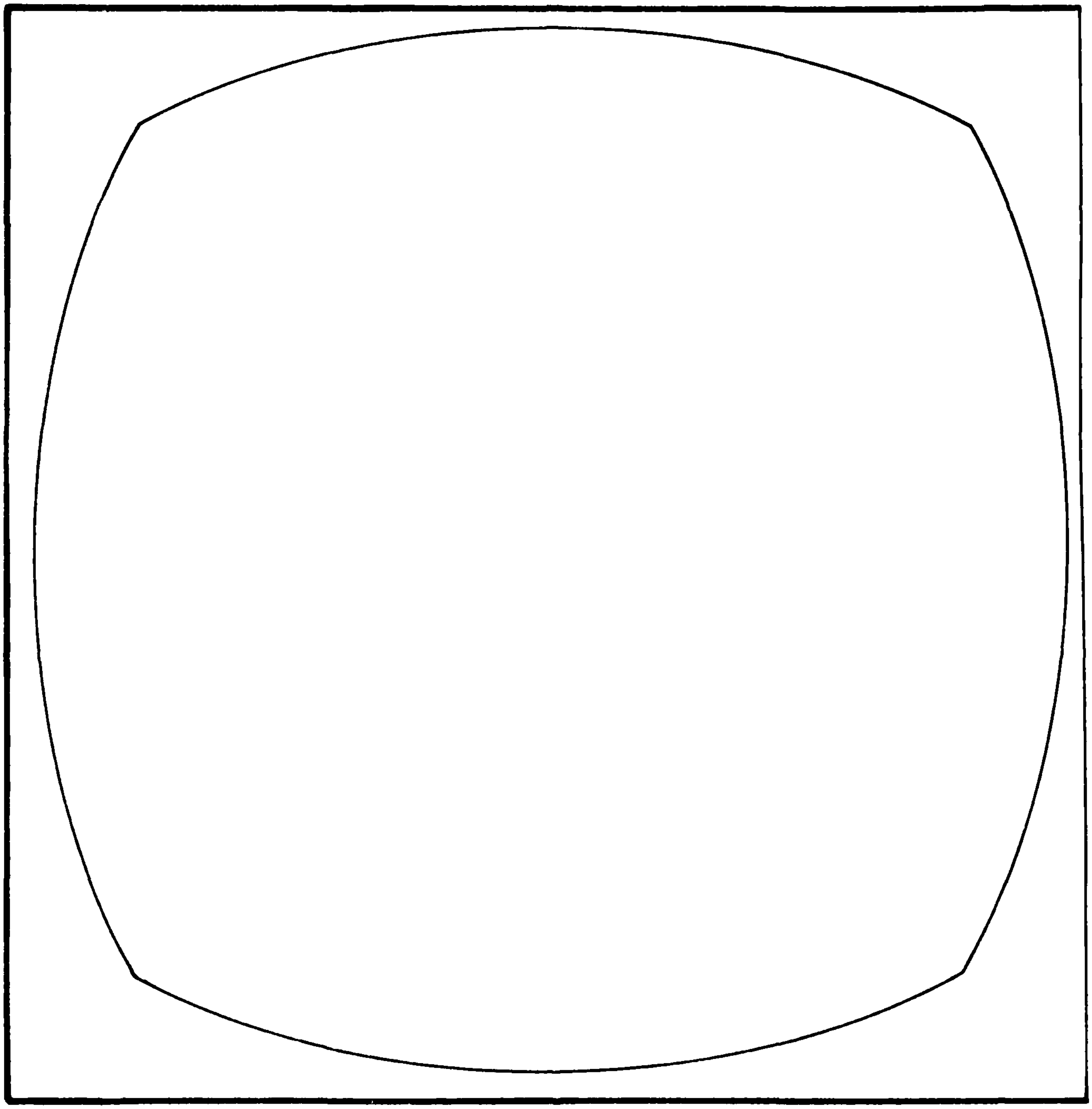


Figure B-10. IOS panels 7, 8, 12, and 14, graphic CRTS.

Table B-10. CRT Page Index, Function and Operation

Page Function	Page Operation
Provides the list of available CRT pages that can be displayed on either of the four graphics CRTs as selected by the IP.	1. Activate the index page by pressing the corresponding CRT # button (i.e. CRT 1, CRT 2, CRT 3, CRT 4) on the CRT control panel (Figure 33).
	2. Determine the page to be displayed and on what CRT it is to be presented.
	3. Press the button on the CRT control panel keyboard of the number of the page to be displayed.
	4. Press the SEL (select) button. This will cause the page title on the index page to flash.
	5. Press the button on the CRT control panel keyboard of the number of the CRT on which the page is to be displayed.
	6. Press the ENT (enter) button. This will cause the desired page to appear on the CRT selected. The page title will discontinue flashing.

Note -

A. To display the index page at any time on any CRT:

1. Press the CRT # button to designate the CRT on which the index page is to appear.
2. Press the INDX PAGE button on the CRT Control Panel

B. To delete a CRT page:

1. Press the CRT # button to designate the CRT to be cleared.
2. Press the CLR PAGE button on the CRT control panel.

CRT PAGE INDEX

		ASSIGN TO CRT #			
1	AIRCRAFT CONFIGURATION	1	2	3	4
2	AIRFIELD/RANGE INDEX	1	2	3	4
3	ENVIRONMENT	1	2	3	4
4	WEAPONS/STORES	1	2	3	4
5	MALFUNCTION SET	1	2	3	4
6	BOMB SCORING	1	2	3	4
7	TARGET APPROACH	1	2	3	4
8	TARGET APPROACH - STRAFE	1	2	3	4
9	FLIGHT CONTROLS	1	2	3	4
10	ACTIVE MANEUVER LIST	1	2	3	4
11	ACTIVE MANEUVER SCORING PROFILE	1	2	3	4
12	CRASH CONDITIONS	1	2	3	4

Figure B-11. Graphic CRT page, CRT page index.

Table B-11. **Aircraft Configuration Page, Function and Operation**

Page Function	Page Operation
Enables the IP to reconfigure the simulated aircraft. Each parameter has a predetermined value. If the parameter value is changed, the preset configuration can be reattained by activating the initial condition (INIT COND) button on the CRT control.	1. Activate this page by pressing the corresponding CRT # button. 2. Press the button on the keyboard corresponding to the parameter. 3. Press the SEL button. The parameter will flash. 4. Use the keyboard for the new parameter value. The digits selected will appear under the NEW column. 5. Press the ENT button. This action reconfigures the aircraft and the parameter discontinues flashing.

NOTE: To move the CRT page to any other CRT:

1. Activate the appropriate CRT from the CRT control panel.
2. Key in 99 on the keyboard.
3. Press the SEL button.
4. Key in the number of the keyboard of the CRT on which the page is to be moved.
5. Press the ENT button.

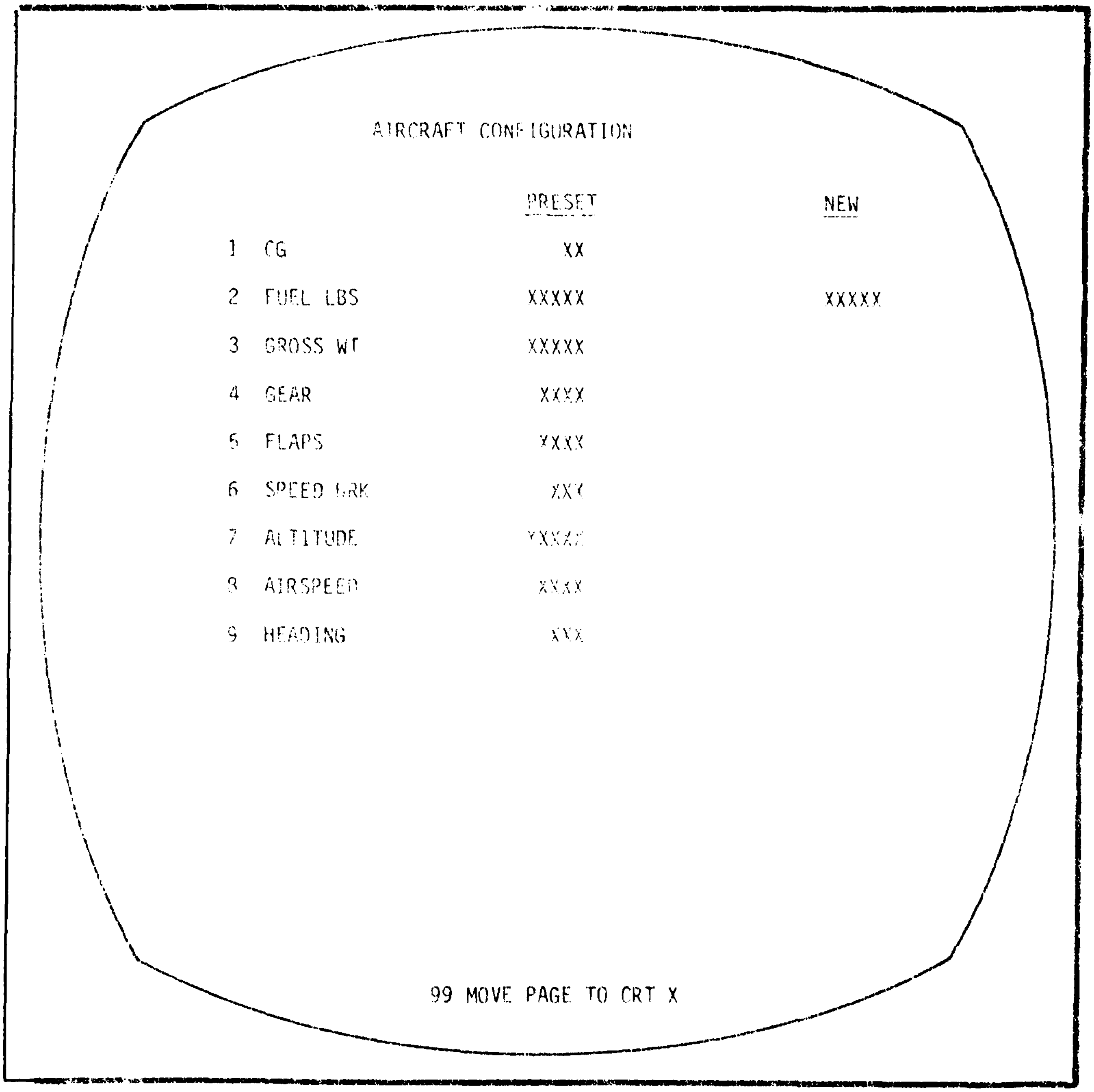


Figure B-12. **Graphic CRT page, aircraft configuration.**

Table B-12. **Initial Position Index Page, Function and Operation**

Page Function	Page Operation
Permits the IP to display any preprogrammed airfield or weapons delivery range.	1. Activate this page by pressing the corresponding CRT # button.
	2. Press the button on the keyboard corresponding to the desired airfield/range.
	3. Press the SEL button. The airfield/range selected will flash.
	4. Press the button on the keyboard corresponding to the CRT on which the airfield or range is to be displayed.
	5. Press the ENT button. The airfield or range will appear on the CRT selected.

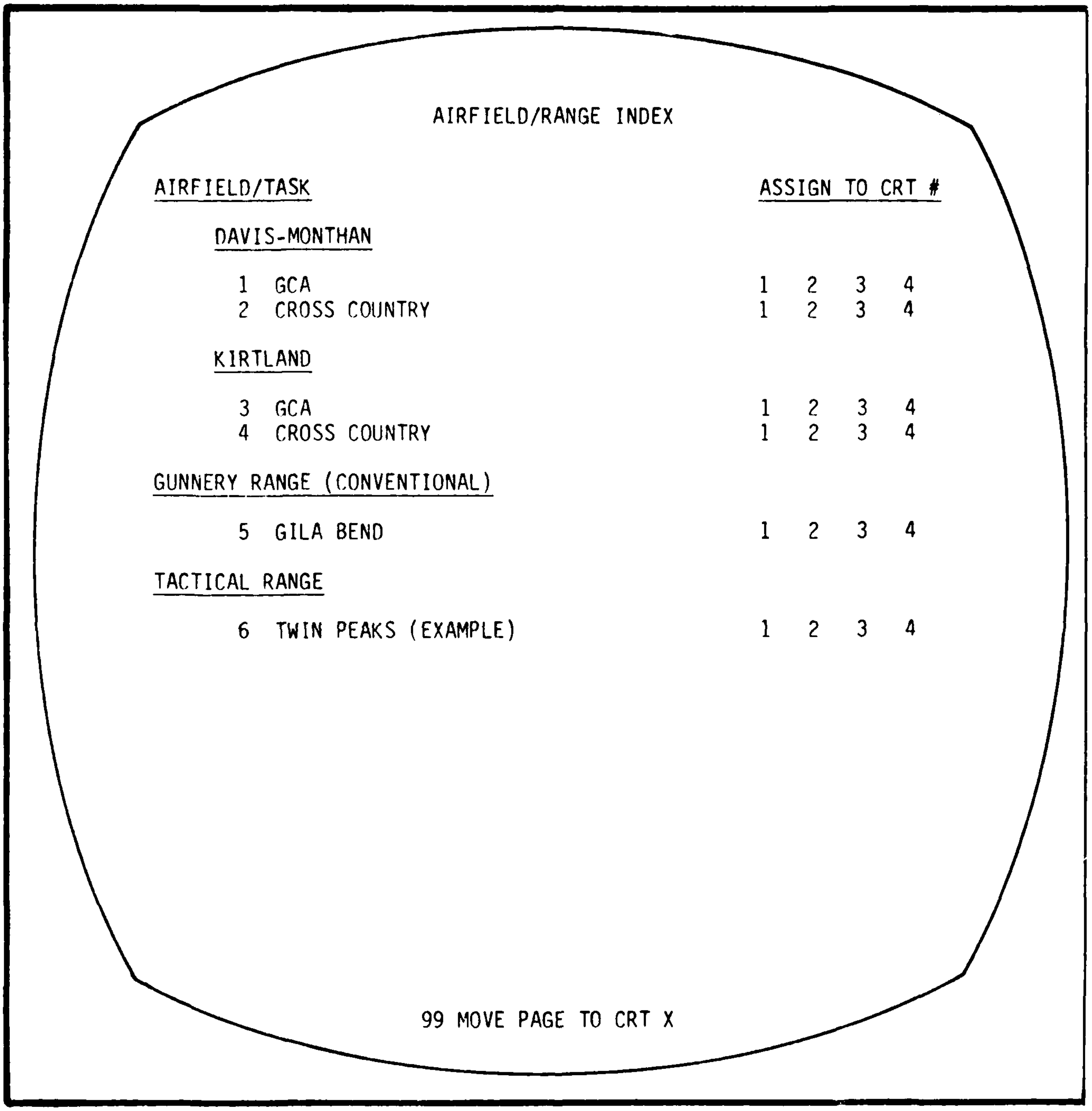


Figure B-13. **Graphic CRT page, initial position index.**

Table B-13. **Airfield (GCA) Page, Function and Operation**

Function	Operation
Provides approach plate for the airfield selected by IP on the INITIAL POSITION INDEX page. Radio frequencies and checkpoints are preset for the specified airfield, but they can be changed by the IP. Touchdown parameter values are displayed automatically at touchdown. The altitude scale factor changes automatically (i.e., x100 to x10). Centerline (CL), glideslope (G/S) and altitude (ALT) indicators use fixed scales and moving pointers. Present aircraft position is shown by the filled circle and the aircraft track by trail dots.	To change radio frequencies and check points: 1. Activate this page by pressing the corresponding CRT # button. 2. Press the button on the keyboard corresponding to number of the parameter to be to be changed. 3. Press the SEL button. The parameter will flash. 4. Use the keyboard for the new parameter value. The new value will replace the preset values. To reacquire the preset values at any time, press the INIT COND button on the CRT control panel. 5. Press the ENT button. This activates the new values and the parameter discontinues flashing.

Table B-13 (*Continued*)

Function	Operation
The initial start position in both the ground plane and altitude can be changed by the IP from the CRT control panel.	1. Activate this page by pressing the corresponding CRT # button. 2. Press the ENABLE button of the aircraft position (A/C POS) functions on the CRT control panel. 3. Press either the azimuth (AZI) or altitude (ALT) button for the parameter to be changed. The buttons will light when activated. 4. Use the track ball to move the aircraft position (filled circle) or altitude pointer on the map to the desired position. 5. Press the SET button to disable this function and activate the aircraft at the new position. The ENABLE button light and AZI or ALT lights will be extinguished when the set button is pressed.

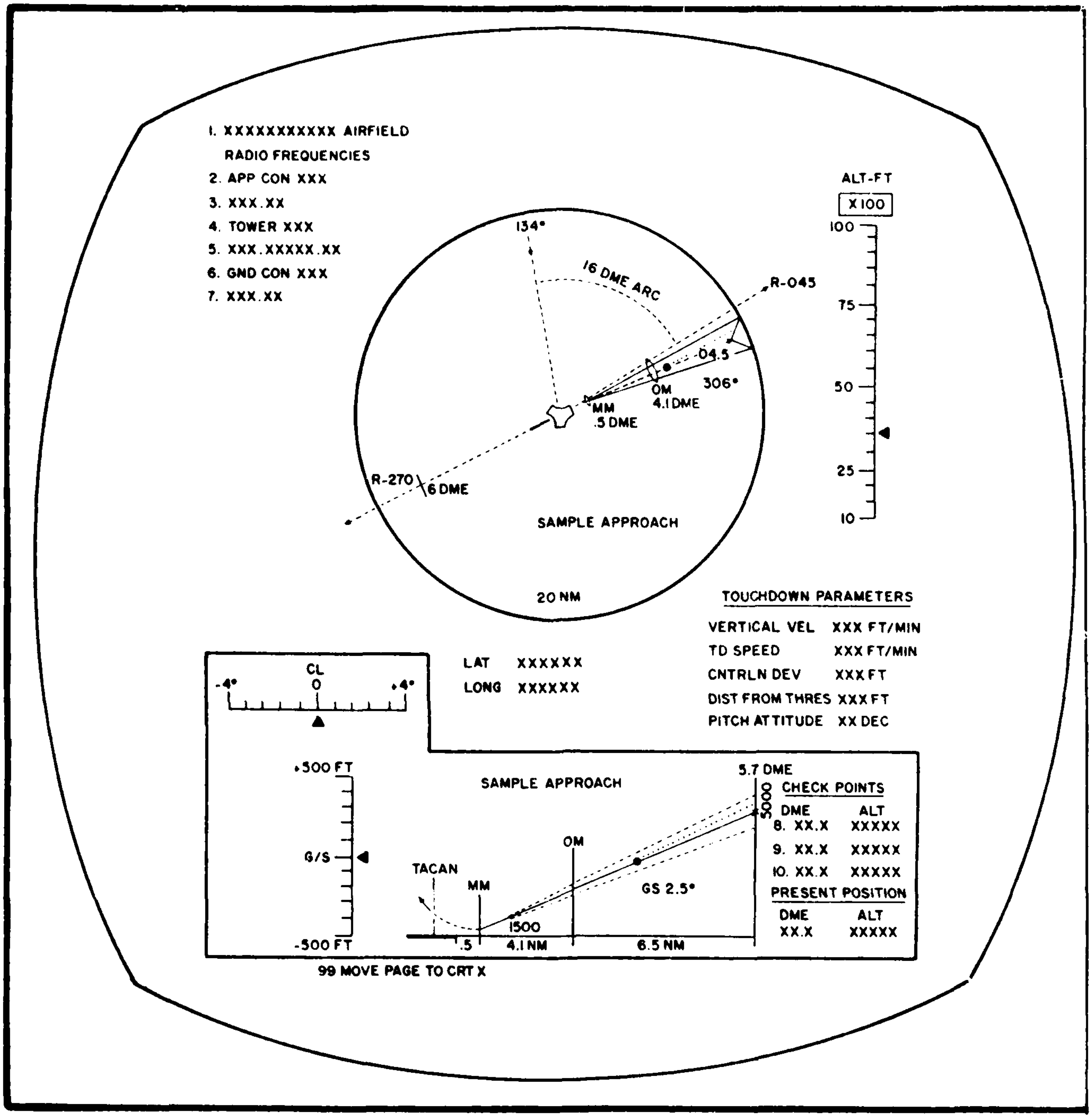


Figure B-11. Graphic CRT page, sample airfield (GCA).

Table B-11. Cross Country/Navigation Map Page, Function and Operation

Function	Operation
Provides a navigation map for the area selected by IP on the INITIAL POSITION index page. Present aircraft positionis shown by the filled circle and the aircraft track by trail dots.	
The initial start position in both the ground plane and altitude can be changed by the IP from the CRT control panel.	1. Activate this page by pressing the corresponding CRT # button. 2. Press the ENABLE button on the CRT control panel. 3. Press either the AZI or ALT button for the parameter to be changed. 4. Use the track ball to move the aircraft position (filled circle) or altitude pointer on the map to the desired position. 5. Press the SET button to disable this function and activate the aircraft at the new position.

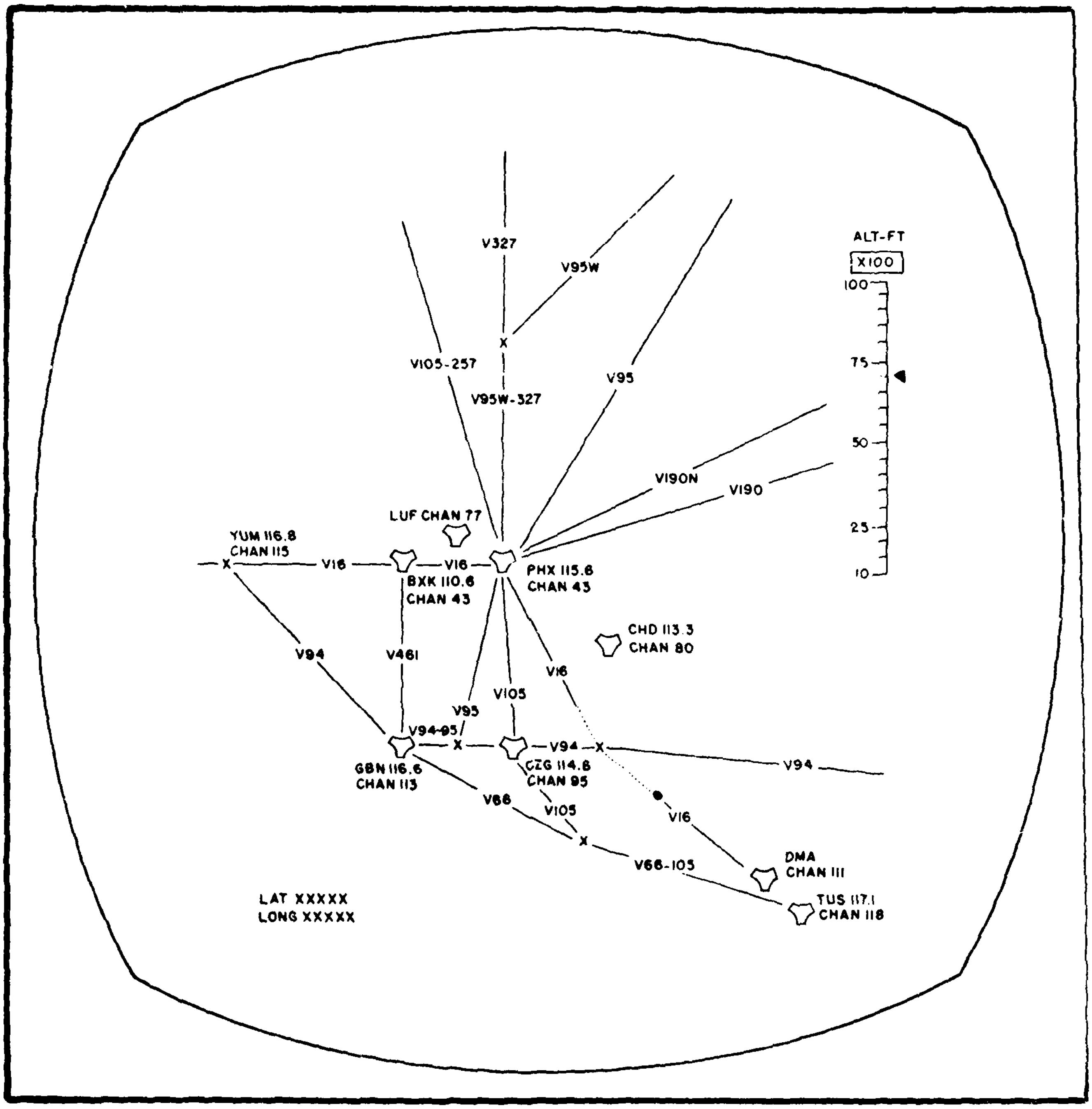


Figure B-15. Graphic CRT page, cross country/navigation map.

Table B-15. Tactical Environment Page, Function and Operation

Function	Operation
Depicts the tactical environment, aircraft position, and aircraft track. Provides weapons release paramaters circular bomb drop error, and strafe scoring. The display can be rotated in both the X & Y coordinates to provide 3-D capability. The aircraft can be positioned at any start point using the same procedure described in Table 33.	1. Activate this page by pressing the corresponding CRT # button. 2. Press the 3-D button of the range function. The button will light. 3. Use the track ball to rotate the display. 4. Press the 3-D button to extinguish the light and deactivate this function.

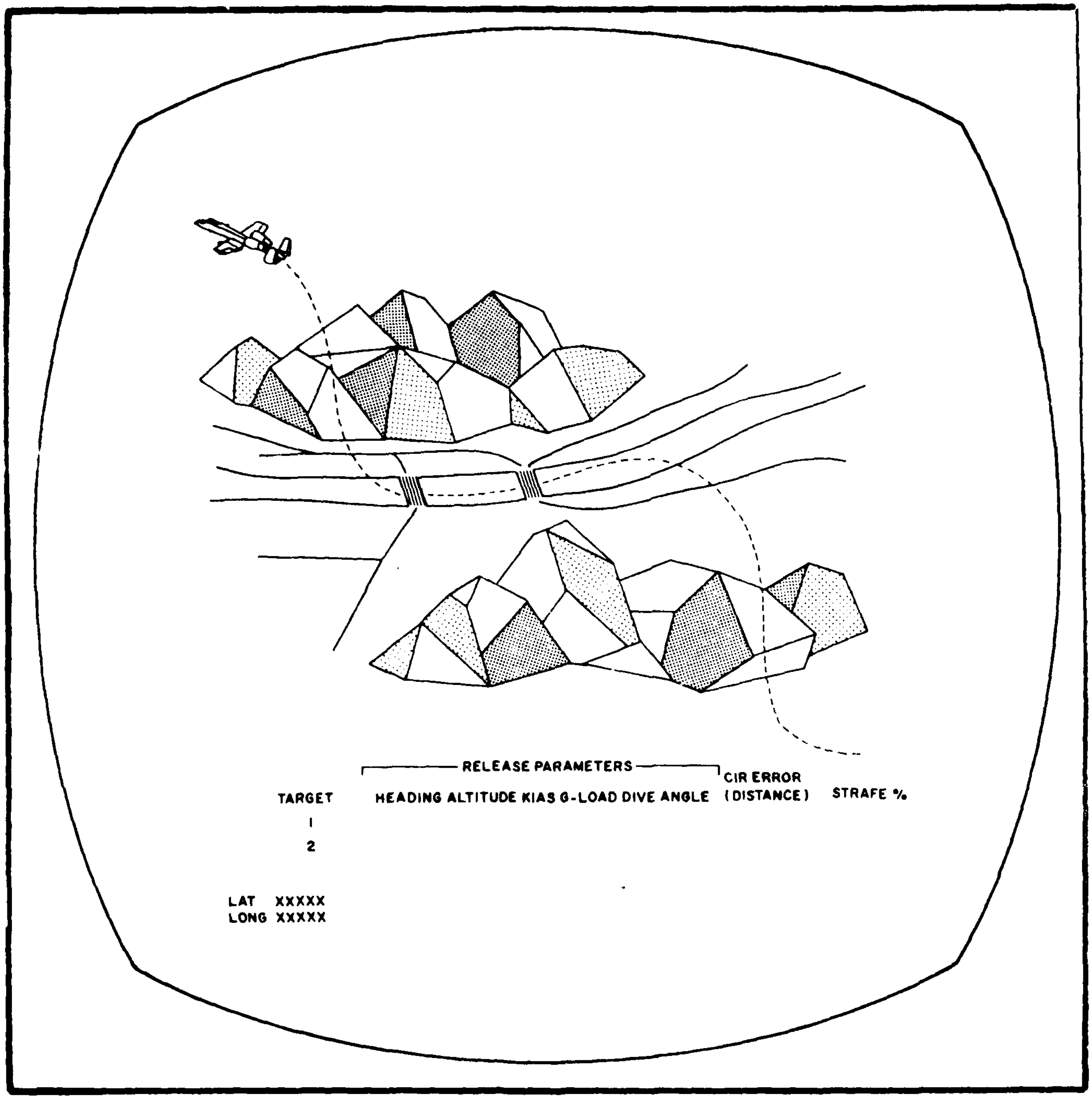


Figure B-16. Graphic CRT page, tactical environment.

Table B-16. **Environment Page. Function and Operation**

Function	Operation
Enables the IP to set the environmental conditions. The parameters have preset values that are most often used in training. If the parameter value is changed, the preset condition can be reattained by pressing the INIT COND button.	1. Activate this page by pressing the corresponding CRT # button. 2. Press the button on the keyboard corresponding to the parameter. 3. Press the SEL button. The parameter will flash. 4. Use the keyboard for the new parameter value. The digits selected wil appear under the new column. 5. Press the ENT button. The new environmental condition is then activated and the parameter discontinues flashing.

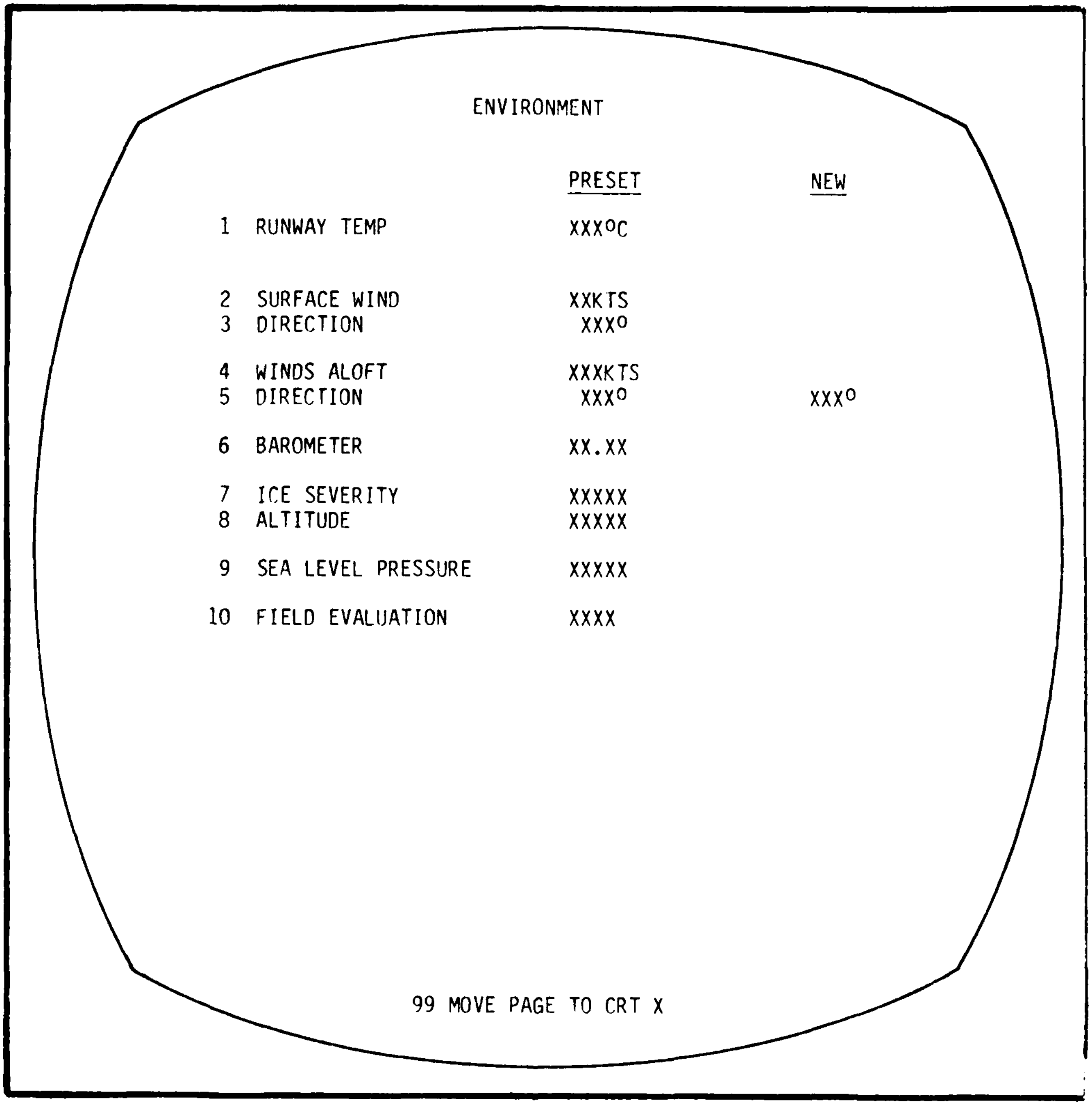


Figure B-17. Graphic CRT page, environment.

Table B-17. **Weapons/Stores Page, Function and Operation**

Function	Operation
Enables the IP to load a variety of weapons on the simulated aircraft.	1. Activate this page by pressing the corresponding CRT # button. 2. Press the button on the keyboard corresponding to the weapons station on the aircraft to be loaded. 3. Press the SEL button. The station number will flash. 4. Press the button on the keyboard corresponding to the stores to be loaded. The stores selected will flash. 5. Press the ENT button. The stores number will appear at the station and both stores and station will discontinue flashing.

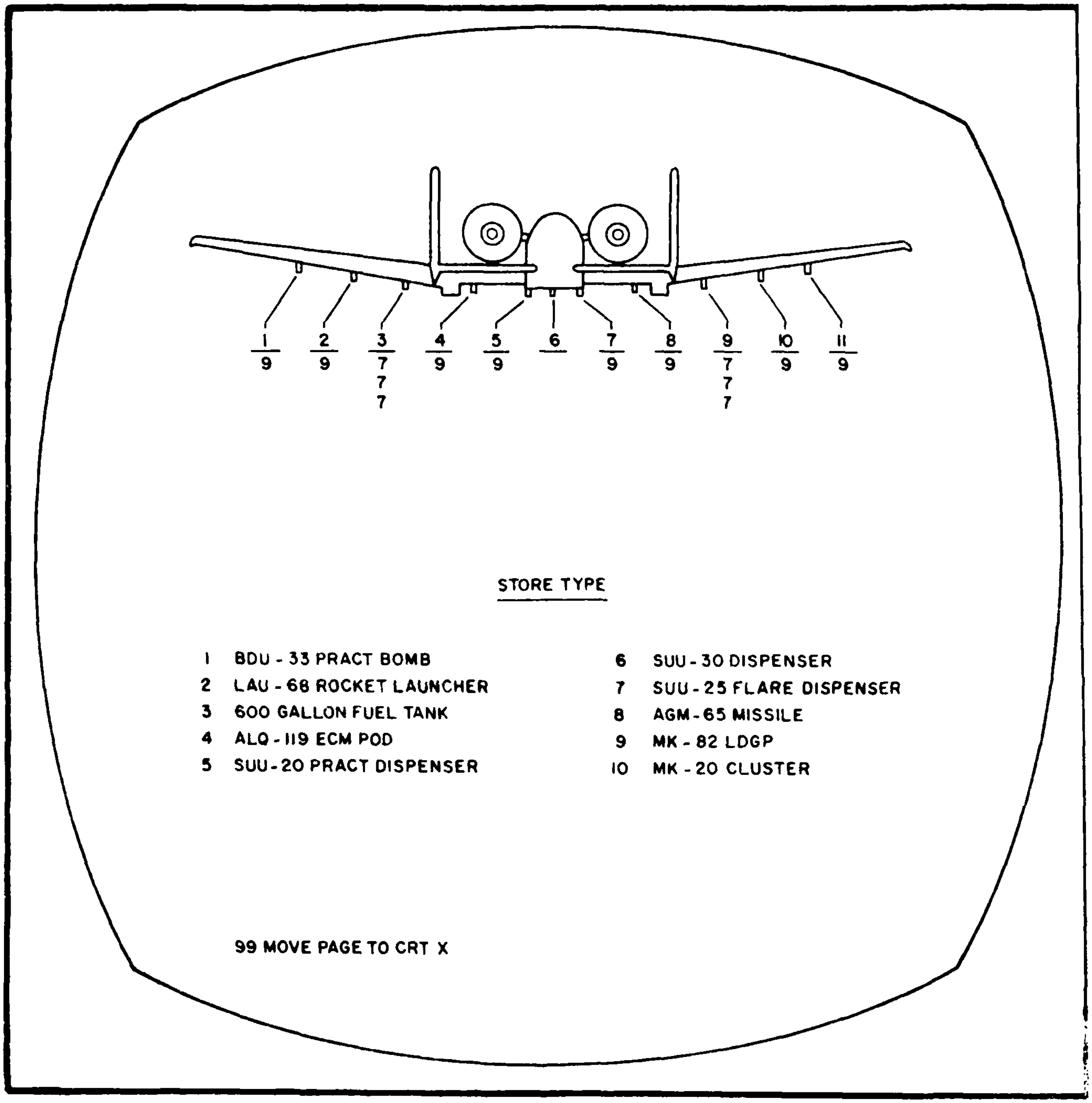


Figure B-18. Graphic CRT page, weapons/stores.

Table B-18. Malfunction Set Page, Function and Operation

Function	Operation
Enables IP to fail any aircraft function.	1. Activate this page by pressing the corresponding CRT # button. 2. Press the button on the keyboard for the malfunction desired. 3. Press the SEL button. The malfunction selected will flash. 4. Press the ENT button. The malfunction will now occur and discontinue flashing on the CRT page. The caution panel will indicate the occurrence of the malfunction. 5. Multiple malfunctions can be inserted: Do not press the ENT button until all of them have been selected.

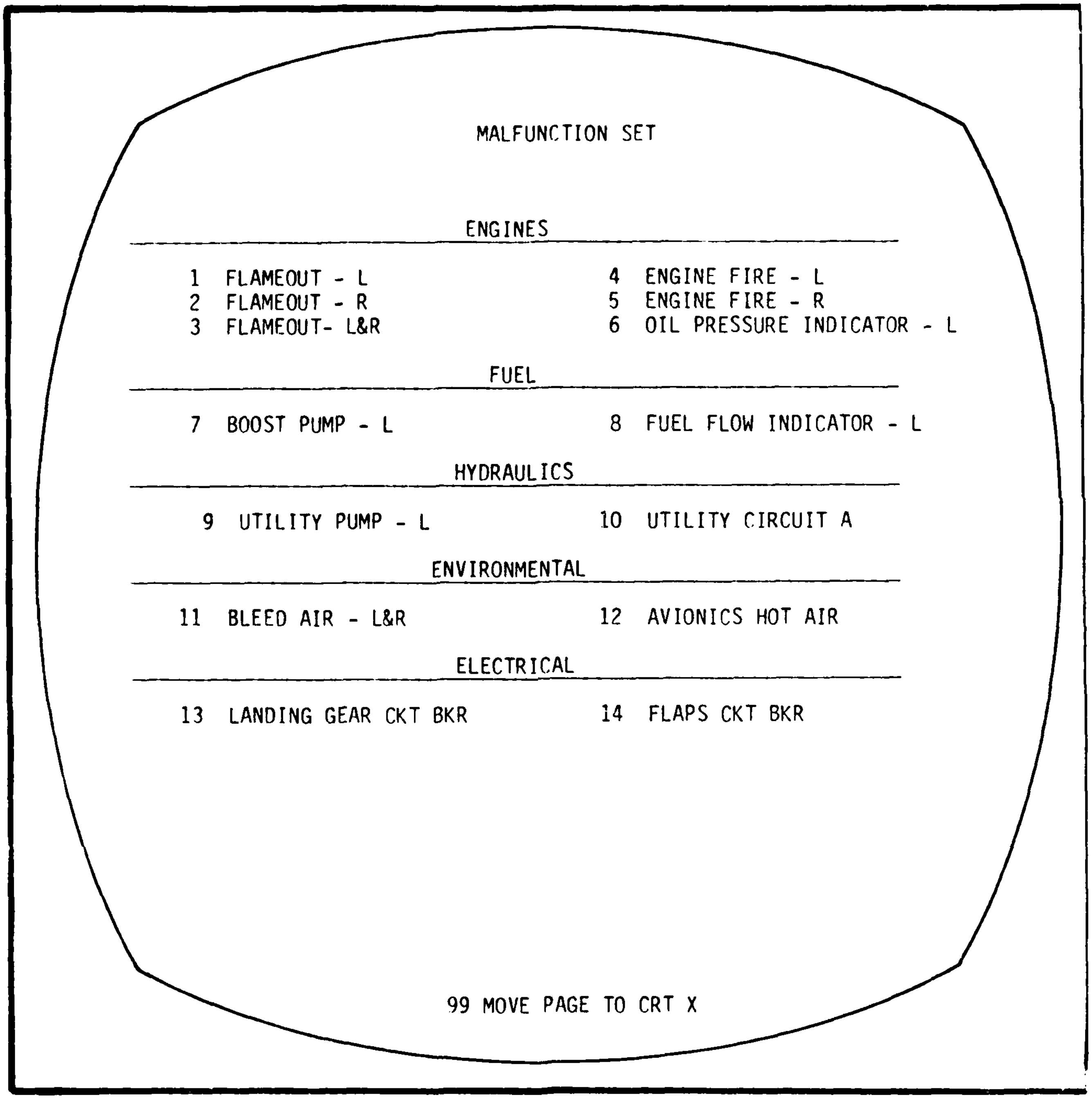


Figure B-19. Graphic CRT page, malfunction set.

Table B-19. **Bomb Scoring Page, Function and Operation**

Function	Operation
Provides a bomb circle and the impact point for each delivery. The "tick" mark on each impact point shows the direction the aircraft was headed. Bomb release parameters are tabulated, along with the winds and circular bomb drop error. A running error average is computed and printed on the CRT.	This page is for performance monitoring. The only operation that can be performed is to move this page to another CRT.

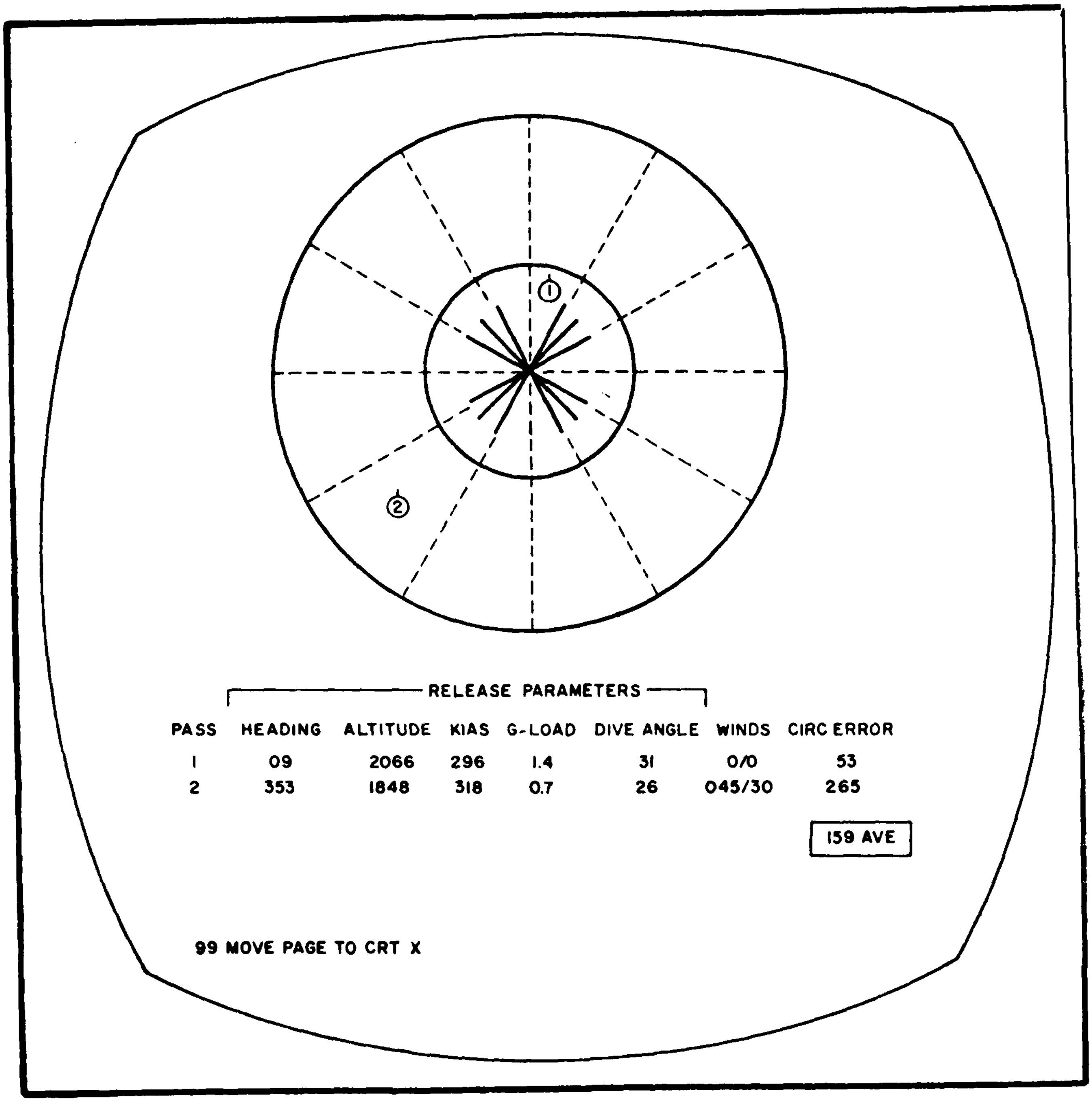


Figure B-20. Graphic CRT page, bomb scoring.

Table B-20. Target Approach Page, Function and Operation

Function	Operation
Depicts the ground path of the aircraft and aircraft dive angle relative to the target in weapons delivery training at the conventional gunnery range. The miniature aircraft shows the present position and the track of the aircraft is represented with trail dots.	
The initial start position in both the ground plane and altitude can be changed by the IP from the CRT control panel.	1. Activate this page by pressing the corresponding CRT # button. 2. Press the ENABLE button on the CRT control panel. 3. Press either the AZI or ALT button for the parameter to be changed. 4. Use the track ball to reposition the aircraft symbol. 5. Press the SET button to disable this function and activate the aircraft at the new position.

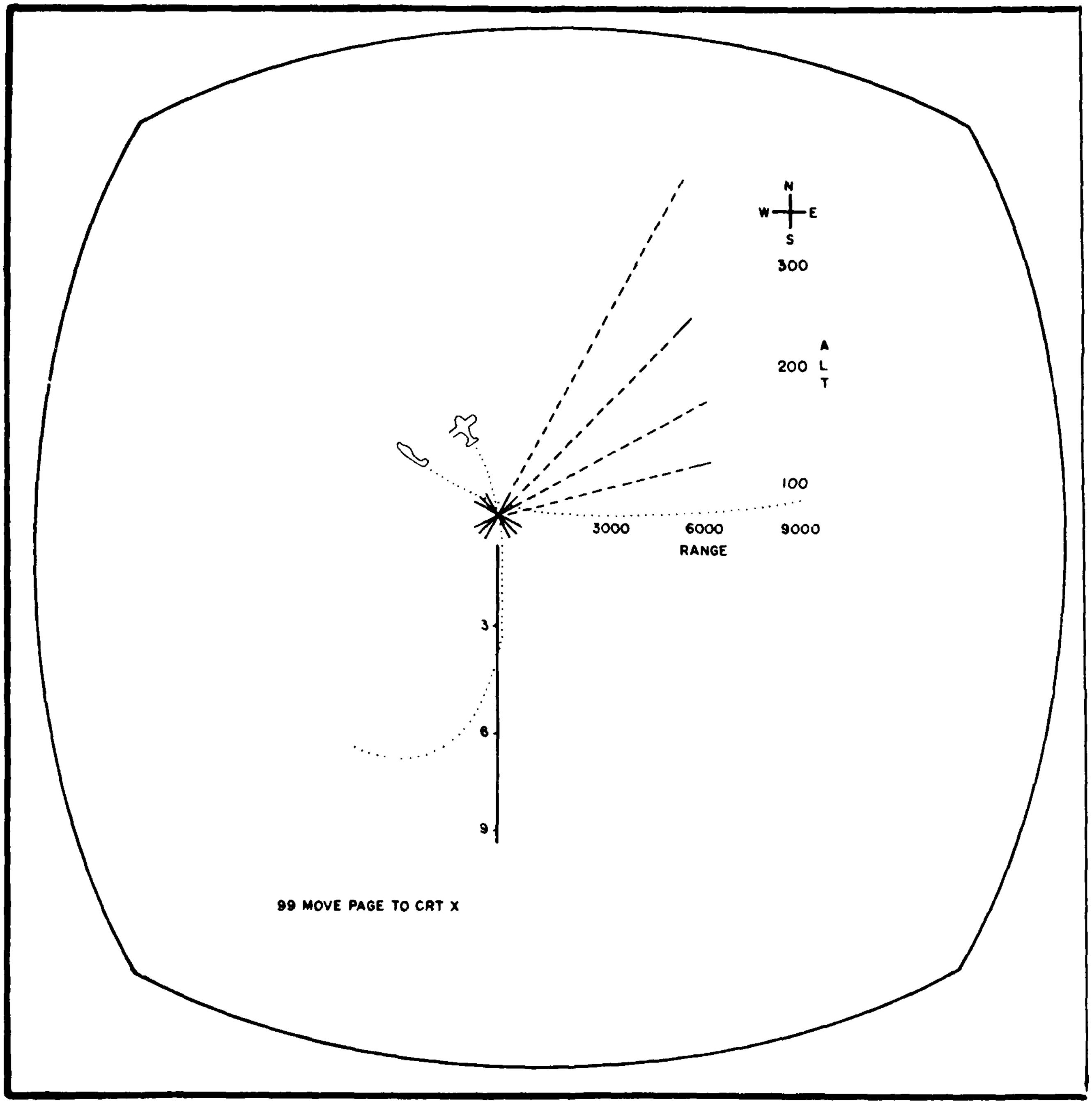


Figure B-21. Graphic CRT page, target approach.

Table B-21. Target Approach - Strafe Page, Function and Operation

Function	Operation
Depicts the ground path of the aircraft and aircraft dive angle relative to the target in weapons deliery training at the conventional gunnery range. The miniature aircraft shows the present position and the track of the aircraft is represented with trail dots. The strafe score (in percent hits) is printed on the CRT along with the number of rounds fired and a foul readout if a foul occurs.	
The initial start position in both the ground plane and altitude can be changed by the IP from the CRT control panel.	1. Activate this page by pressing the corresponding CRT # button. 2. Press the ENABLE button on the CRT control panel. 3. Press either the AZI or ALT button for the parameter to be changed. 4. Use the track ball to reposition the aircraft symbol. 5. Press the SET button to disable this function and activate the aircraft at the new position.

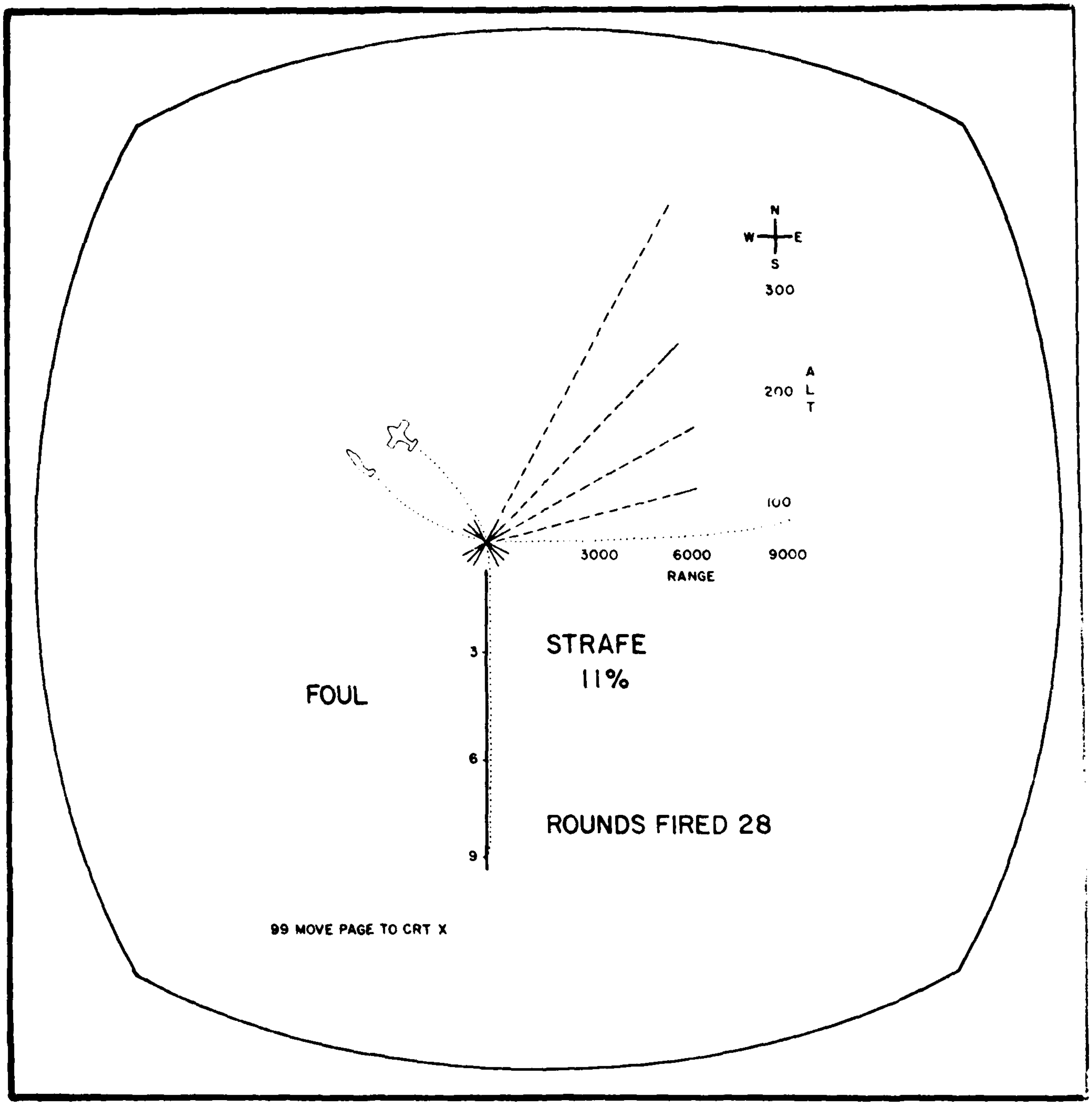


Figure B-22. Graphic CRT page, target approach-strafe.

Table B-22. **Flight Controls Page, Function and Operation**

Function	Operation
Graphically illustrates the extent of stick and rudder deflection from the neutral position and the amount of force being applied to the controls. The trim indicators light when the pilot trims the control surfaces.	This page is for performance monitoring. The only operation that can be performed is to move this page to another CRT.

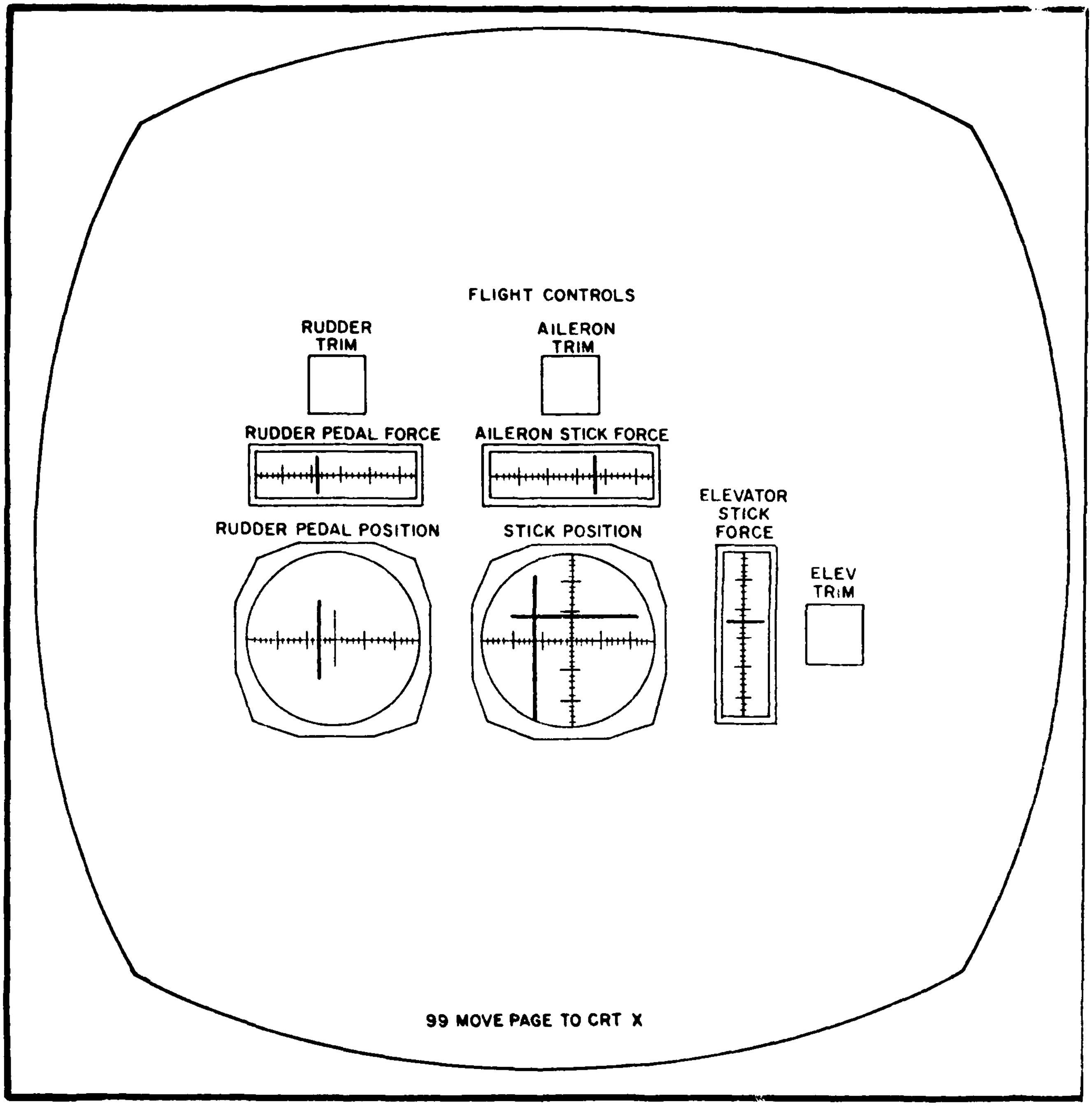


Figure B-23. Graphic CRT page, flight controls.

Table B-23. **Active Maneuvers Page, Function and Operation**

Function	Operation
The list of maneuvers that can be scored automatically are provided in this page.	1. Activate this page by pressing the corresponding CRT # button. 2. Press the button on the keyboard for the maneuver to be scored. 3. Press the SEL button. The maneuver will flash. 4. Press the button on the keyboard for the CRT on which the scoring profile is to appear. 5. Press the ENT button. The scoring profile (Figure 31) will appear on the CRT selected and the maneuver will stop flashing.

LIST OF MANEUVERS (TASKS) COMPRISING ACTIVE EXCERCISE

			ASSIGN TO CRT #			
1	TASK 1	TAKEOFF, CLIMB, LEVEL OFF	1	2	3	4
2	TASK 2	STALL PRACTICE, SLOW FLIGHT	1	2	3	4
3	TASK 3	LAZY 8, AIR ROLL, AIL ROLL	1	2	3	4
4	TASK 4	LOOP, CUBAN 8, SPLIT S	1	2	3	4
5	TASK 5	DESCENT, STRAIGHT-IN, GO-AROUND	1	2	3	4
6	TASK 6	RE-ENTRY, NORMAL OVHD, GO-AROUND	1	2	3	4
7	TASK 7	CLOSED, NORMAL OVHD, GO-AROUND	1	2	3	4
8	TASK 8	CLOSED, NORMAL OVHD, GO-AROUND	1	2	3	4
9	TASK 9	CLOSED, NORMAL OVHD, TOUCH & GO	1	2	3	4
10	TASK 10	CLOSED, NORMAL OVHD, TOUCH & GO	1	2	3	4
11	TASK 11	CLOSED, NORMAL OVHD, TOUCH & GO	1	2	3	4
12	TASK 12	RE-ENTRY, NORMAL OVHD, FULL STOP	1	2	3	4

99 MOVE PAGE TO CRT X

Figure B-24. Graphic CRT page, active maneuver list.

Table B-21. **Scoring Profile Page, Function and Operation**

Function	Operation
Provides entry and exit values for selected flight parameters and includes minimum and maximum air-speed and altitude.	This page is for performance monitoring. The only operation that can be performed is to move this page to another CRT.

TASK 4 - LOOP, CUBAN 8, SPLIT S

LOOP: AFTER THE TONE, ENTER A DIVE AND GET 290 KNOTS. THEN START

	ENTRY	EXIT	MINIMUM	MAXIMUM
ALTITUDE	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX
AIRSPEED	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX
HEADING	XXXXXXXXX	XXXXXXXXX		
CORE RPM	XXXXXXXXX	XXXXXXXXX		

SCORING STOPS FOR THE LOOP WHEN STUDENT RETURNS TO LEVEL FLIGHT

CUBAN S: AFTER THE TONE ENTER A DIVE AND GET 290 KTS. THEN START.

	ENTRY	EXIT	MINIMUM	MAXIMUM
ALTITUDE	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX
AIRSPEED	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX
HEADING	XXXXXXXXX	XXXXXXXXX		
CORE RPM	XXXXXXXXX	XXXXXXXXX	PITCH AT 90 DEG BANK	XXX.X

SCORING STOPS FOR THE CUBAN 8 WHEN STUDENT RETURNS TO LEVEL FLIGHT

SPLIT S: AFTER TONE, PITCH UP TO +3.5 DEG. START ROLL BELOW 205 KNOTS.

	ENTRY	EXIT	MINIMUM	MAXIMUM
ALTITUDE	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX
AIRSPEED	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX	XXXXXXXXX
HEADING	XXXXXXXXX	XXXXXXXXX		
CORE RPM	XXXXXXXXX	XXXXXXXXX		

SCORING STOPS WHEN LEVEL FLIGHT IS REACHED.

99 MOVE PAGE TO CRT X

Figure B-25. **Graphic CRT page, active maneuver scoring profile.**

Table B-25. **Crash Condition Page, Function and Operation**

Function	Operation
The list of crash conditions is provided in this page. The list can be displayed continuously and the condition will flash if a crash occurs. If the list is not displayed, it will automatically appear on a CRT when a crash occurs with the condition flashing.	The simulation system is automatically frozen when crash occurs. To release the simulator, press the RESET button on the CRT control panel. If the crash condition list is in the automatic display mode, it will disappear.

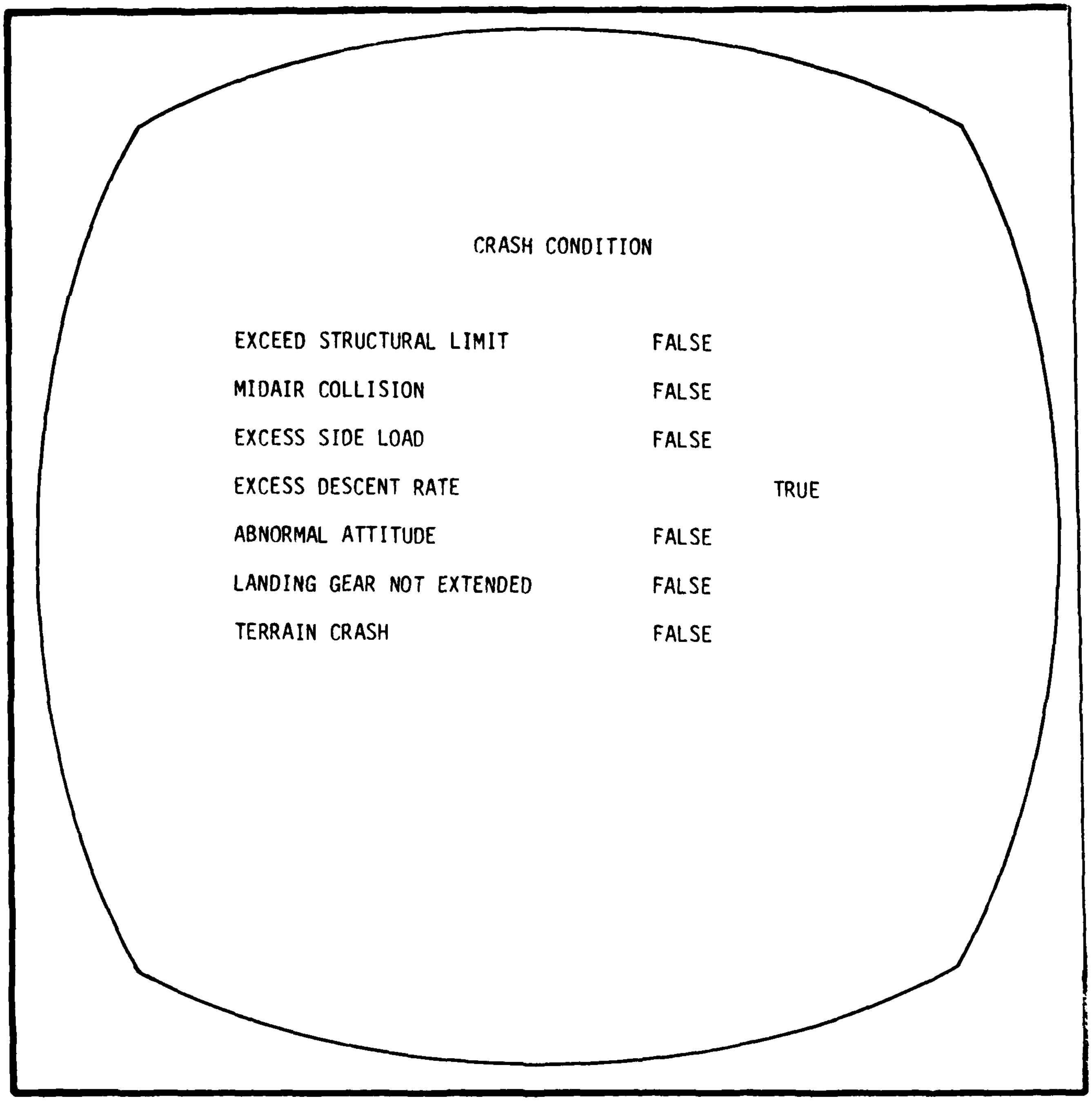


Figure B-26. Graphic CRT page, crash conditions.

Table B-26. IOS Panel No. 19, Functions

Control/Display	Function
CRT Controls	
CRT 1, CRT 2, CRT 3, CRT 4	Activates the corresponding CRT.
Keyboard, SEL, ENT	Provides capability to select and modify CRT page parameters.
INDX PAGE	Recalls INDEX PAGE on the selected CRT (CRT 1 - CRT 4).
CLR PAGE	Clears page on the designated CRT (CRT 1-CRT 4).
ADV PAGE	Displays next page in sequence on the the CRT selected (CRT 1 - CRT 4)
BACK PAGE	Returns preceding page on the CRT activated (CRT 1 - CRT 4).
FRZE	Causes simulator to freeze at the current set of flight conditions. A second depression releases the simulator from the freeze condition.
INIT POS	Reinitializes aircraft at the start point. If the CRT page parameter values had been changed during the mission, these values are retained and define the initial conditions/position.
INIT COND	Activation results in reinitialization of the simulator to the original, preset flight conditions. All parameter values changed during the training missions are erased. This button should be pressed prior to each new training session to reset the simulator to the predetermined flight conditions.

Table B-26 (*Continued*)

Control/Display	Function
CRASH	
OVERRIDE	Prevents the aircraft from crashing when crash conditions are met.
RESET	Eliminates prevailing crash condition and reactivates the aircraft.
MAP	
TRACK BALL	Permits repositioning of the aircraft in altitude and azimuth on the GCA map, navigtion map, tactical range map, and target approach maps, and is used to rotate the tactical range map for the 3-D capability.
ENABLE	Activates the track ball.
AZI	Used in conjunction with the track ball. The aircraft symbol on the maps can be repositioned in the ground plane.
ALT	Used in conjunction with the track ball. The aircraft symbol can be repositioned on the altitude scale of the maps.
SET	Disables the track ball and activates the aircraft at the new position.
3-D	Used in conjunction with the track ball. The tactical range map can be rotated in the X and Y axes.

Table B-26 (*Continued*)

Control/Display	Function
MAP SCALE	
INC	Increases the scale of the maps.
DEC	Decreases the scale of the maps.
TIMER	
HR MIN SEC Readout	Provides a numerical display of the time for specific events.
START	Causes timer to start timing event.
STOP	Stops timer at present displayed readout.
RESET	Causes timer to reset to zero.
AUTO	Sets timer in automatic mode. Timer starts when simulator is taken off freeze and stops when the simulator is put on freeze.

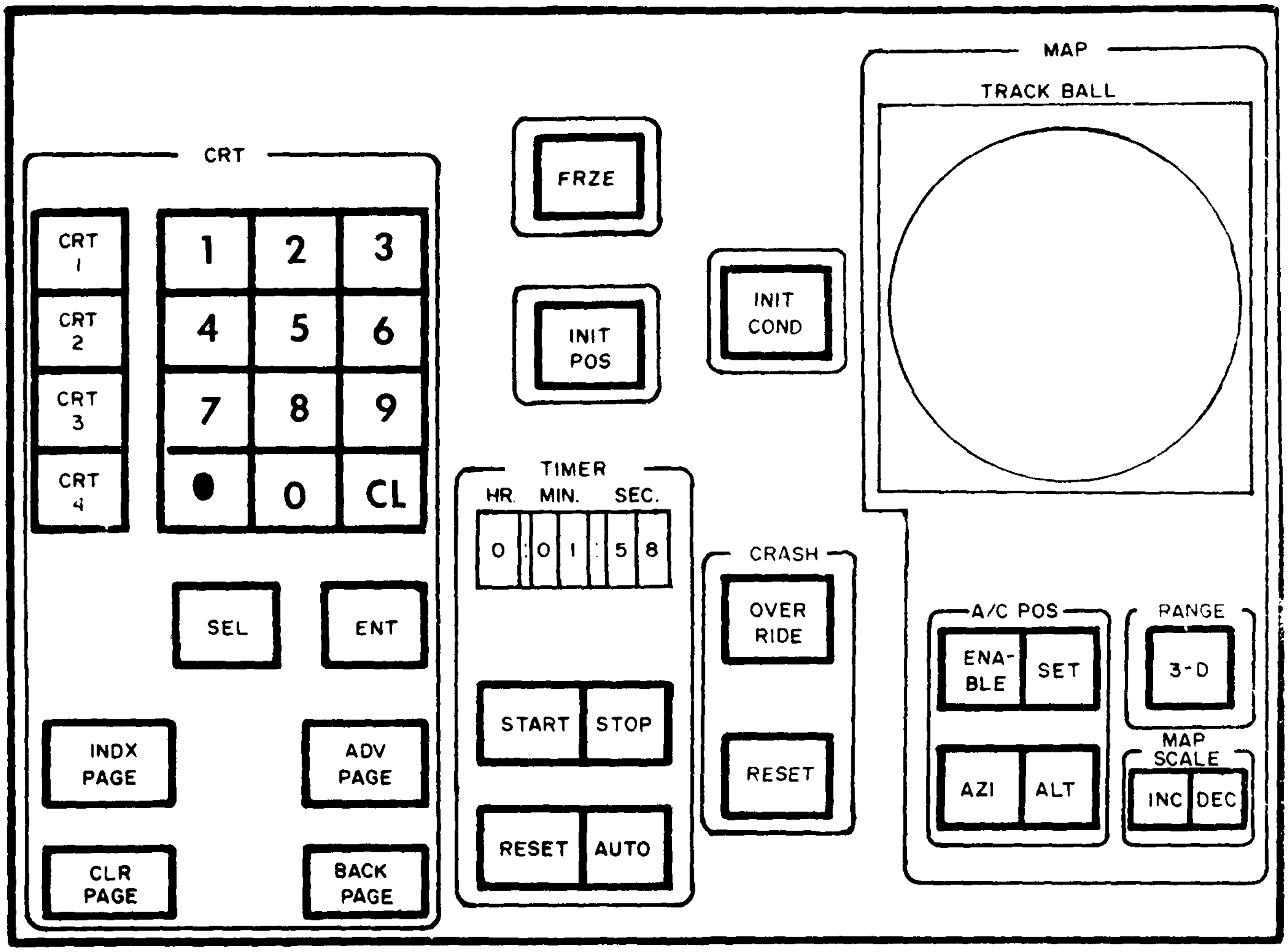


Figure B-27. IOS panel no. 19. CRT controls.

Table B-27. IOS Panel No. 15, Functions

Control/Display	Function
HARDCOPY	
CRT 1, CRT 2, CRT 3, CRT 4	Provides hardcopy of the content for the CRT selected.
AUTO	Hardcopy of the CRT selected is automatically dispensed each time the freeze button is pressed on the CRT control panel.

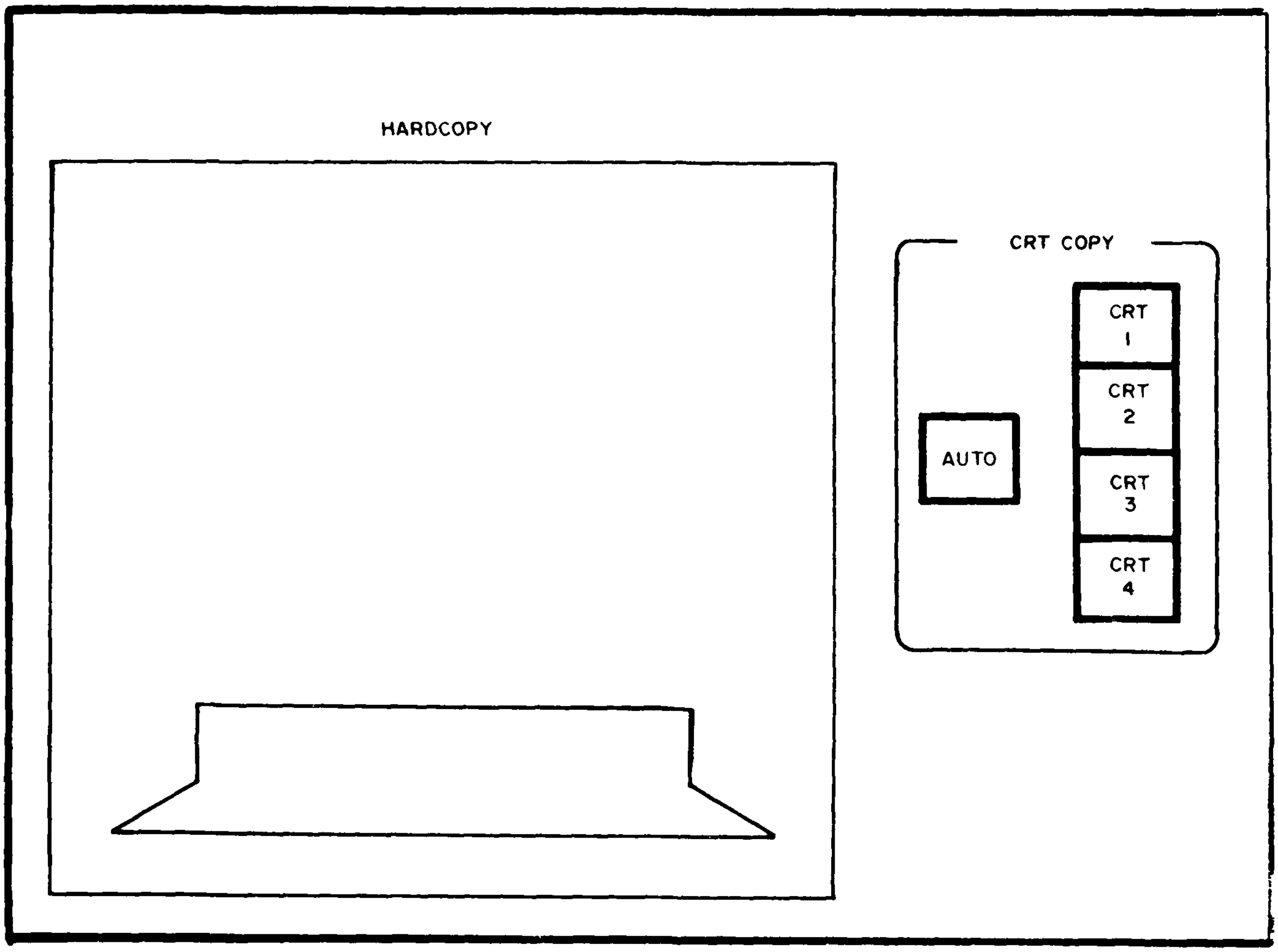


Figure B-28. IOS panel no. 15, hardcopy.

Table B-28. IOS Panel No. 16, Functions

Control/Display	Function
EMER STOP	Removes all electrical power from the simulator, except utility power.

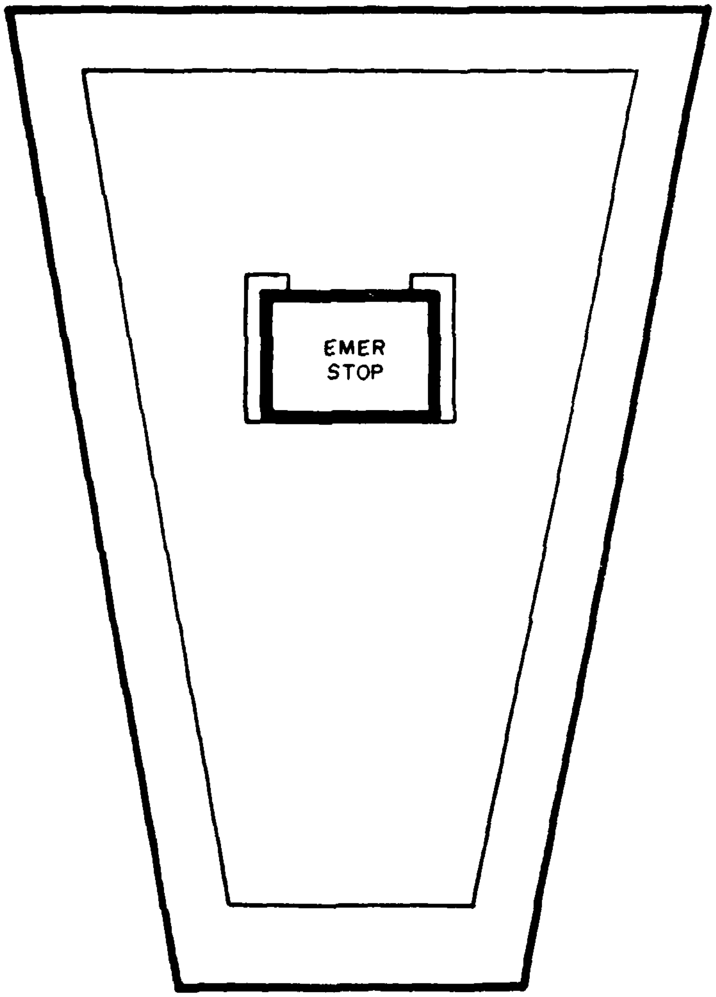


Figure B-29. **IOS panel no. 16, emergency stop.**

Table B-29. **IOS Panel No. 18, Functions**

Control/Display	Function
SPEAKER	
SPKR ON	Turns speaker on or off. Speaker output is from simulator cockpit.
SPKR VOL	Controls speaker volume. Volume is reduced automatically during voice transmissions of the IP from the IOS.
PED MIKE	Provides connection for IP's pedestal mike.
HDSET VOL	Controls volume of headset
HDSET MIKE	Provides connection for IP's headset.

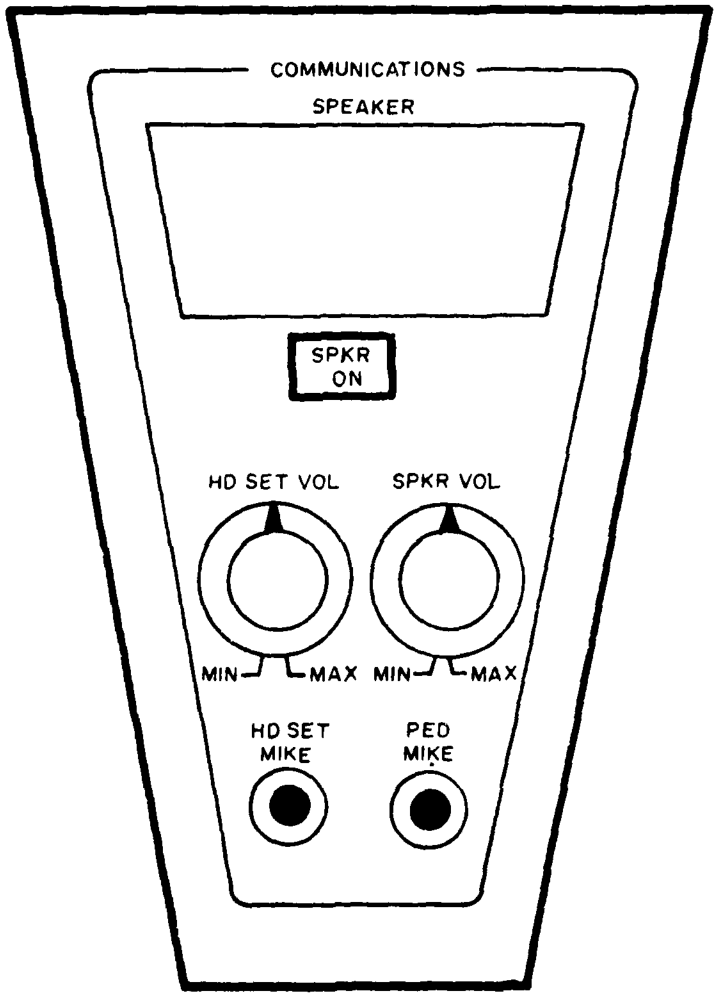


Figure B-30. IOS panel no. 18, communications.

Table B-30. **IOS Panel No. 6, Functions**

Control/Display	Function
IOS Lighting Control	Controls intensity of IOS overhead lights.
IOS LITE ON	Turns on IOS lights.
INDICATOR Control	Controls intensity of illuminated switches and indicators on IOS.
IND LITE ON	Turns on indicator lights.

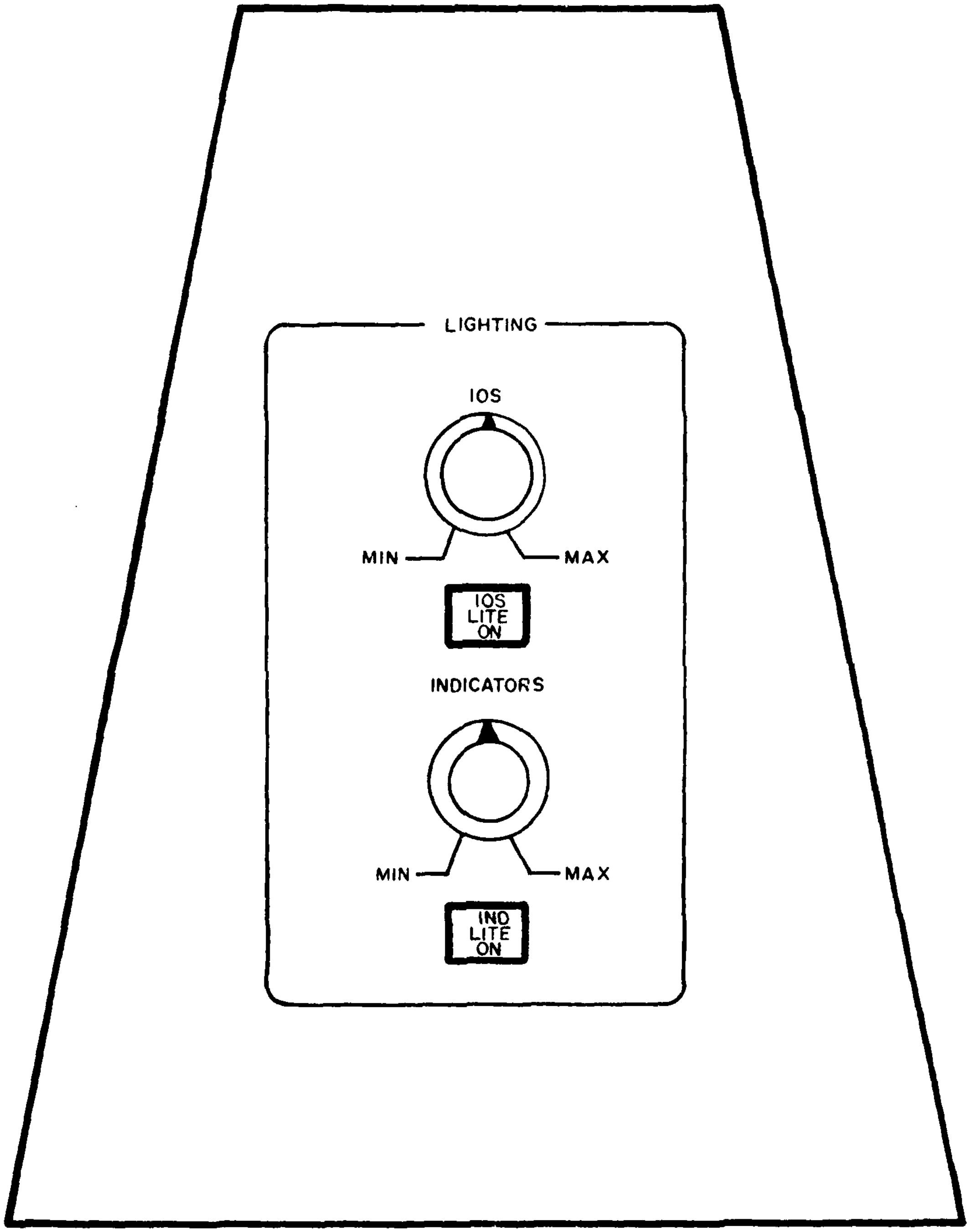


Figure B-31. **IOS panel no. 6, lighting controls.**

Table B-31. **IOS Panel No. 13, Functions**

Control/Display	Function
SIM PWR ON	Provides electrical power to the simulator system.
CONT LOAD ON	Activates the control loading system.
CKPT VIS ON	Activates the visual sytem in the cockpit.

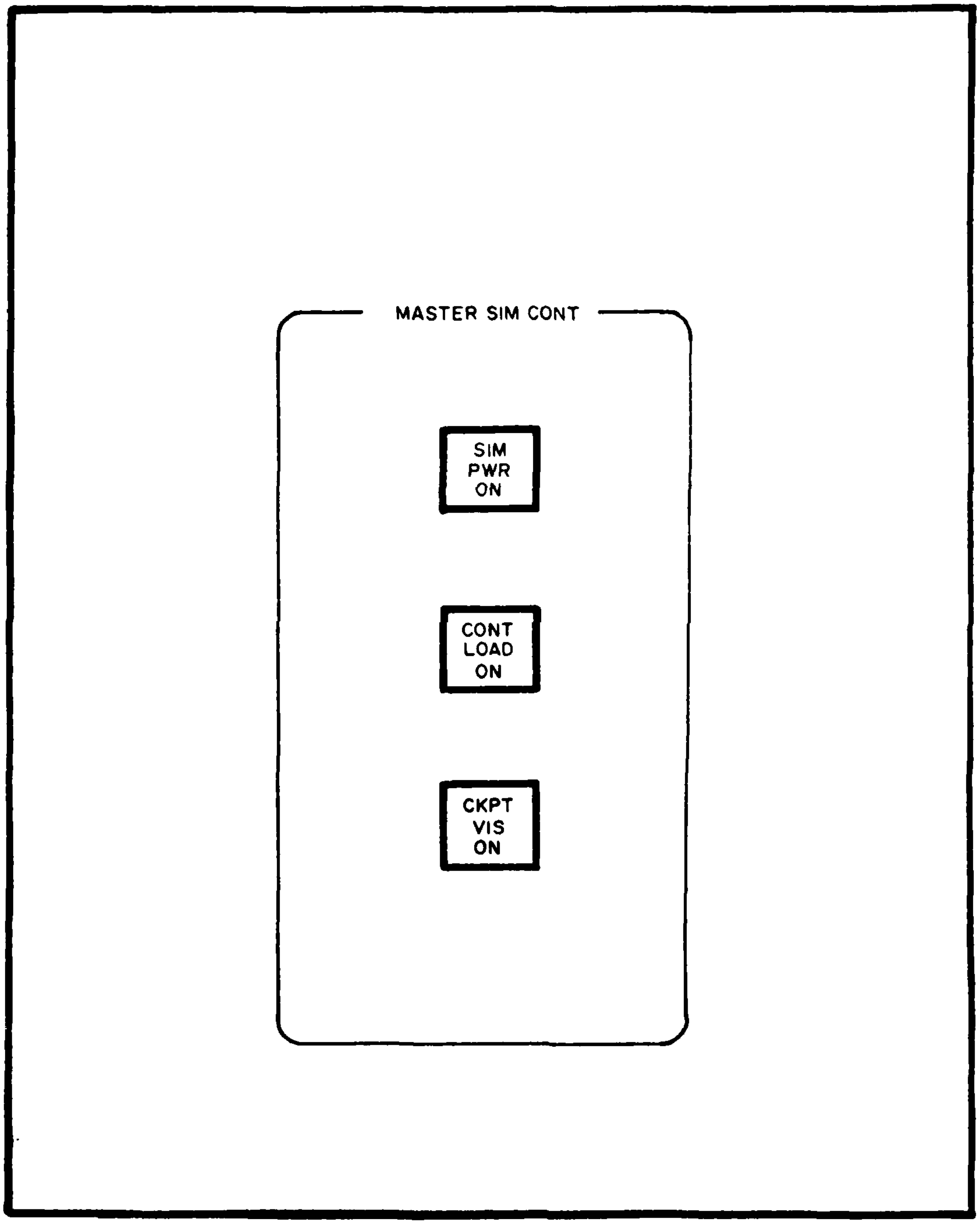


Figure B-32. IOS panel no. 13, master simulator controls.

Table B-32. IOS Panel No. 20, Functions

Control/Display	Function
AIRCRAFT SOUND	
IOS	
SPKR ON	Turns on aircraft sound at IOS speaker.
SPKR VOL	Controls speaker volume of aircraft sound.
HDSET ON	Turns on aircraft sound at IOS headset.
HDSET VOL	Controls headset volume of aircraft sound.
COCKPIT	
SPKR ON	Turns on aircraft sound at cockpit speaker.
SPKR VOL	Controls speaker volume of aircraft sound.
HDSET ON	Turns on aircraft sound at cockpit headset.
HDSET VOL	Controls headset volume of aircraft sound.

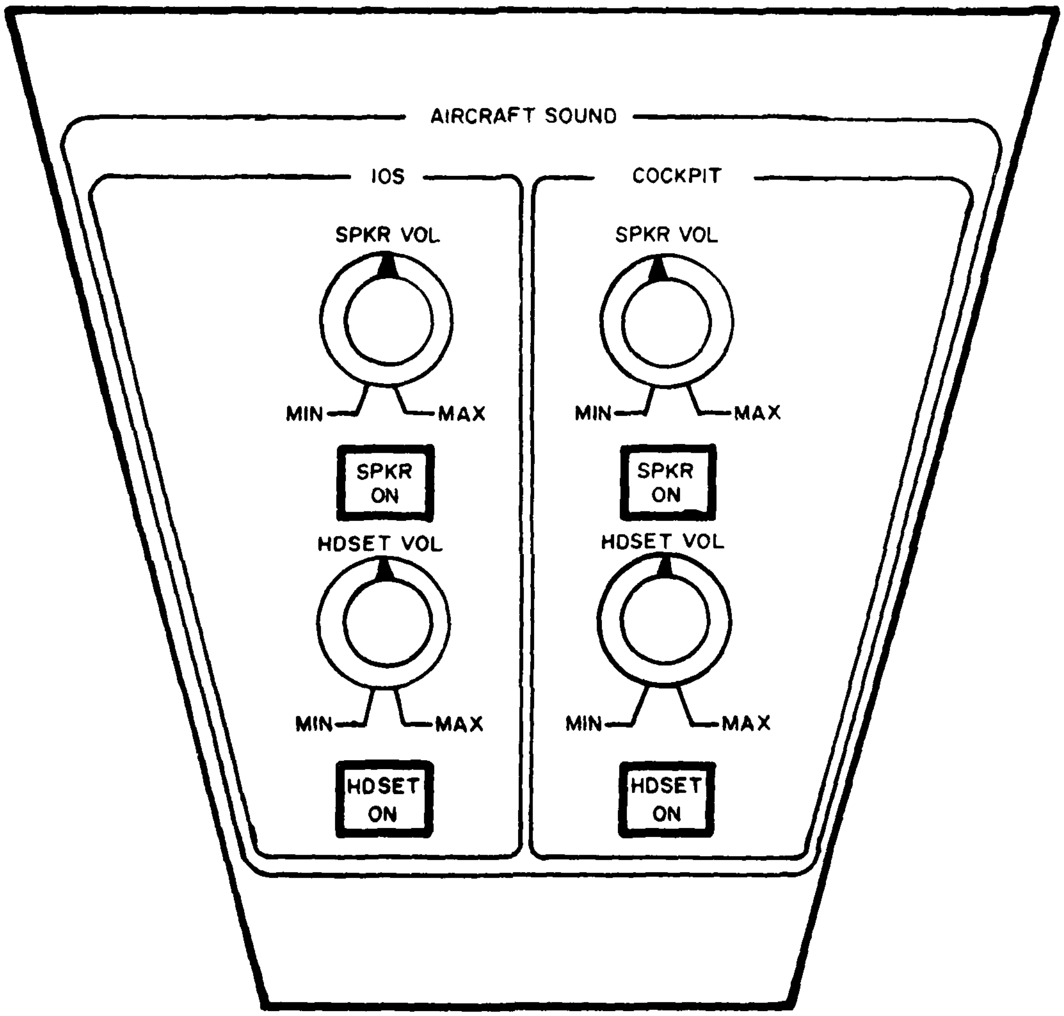


Figure B-33. **IOS panel no. 20, aircraft sound controls.**

Table B-33. **IOS Panel No. 21, Functions**

Control/Display	Function
PREPRO DEMO	
DEMO INDX	Causes list of available preprogrammed flight demonstrations to appear on CRT 3 (Panel No. 14).
THUMBWHEEL	Used to select flight demo for playback.
DEMO INSRT	Activates the selected demo for playback. The demo activated flashes on the CRT.
DEMO PLAYBK (FAST, NORM, SLOW)	Initiates playback of the selected demo at the corresponding speed. When demo is complete, the simulator automatically returns to freeze mode.
STUD PERF	
PERF RECD	Initiates recording of the student's flight performance. Simulator automatically transitions out of freeze mode when switch is activated.
PLAYBK (FAST, NORM, SLOW)	Plays back the student's performance recording at the speed designated.
FRZE	Provides simulator freeze capability.
PROBLEM CONT	
EXT ELEC POWER	Simulates connecting external power to the aircraft.
WHEEL CHOCKS	Simulates aircraft wheel chocks are in place.
GND RATE BOOST	Increases aircraft ground speed.

Table B-33 (*Continued*)

Control/Display	Function
VOICE RECORDER	
STOP	Stops tape.
REWIND	Drives tape at fast speed from take-up reel to supply reel.
FWD	Drives tape at fast speed from supply reel to take-up reel.
PLAY	Plays audio recording at IOS and cockpit speaker/headset.
POWER ON	Activates tape recorder.
RECORD	Activates audio recording.
VOX/MAN	VOX mode permits voice commands to actuate tape recorder. MAN mode provides continuous recording capability.
CCTV CONT	
PAN/TILT	Provides control of horizontal and vertical position of cockpit CCTV camera.
POWER ON	Turns on CCTV camera.
ZOOM (IN, OUT)	Provides camera zoom capability.
IRIS (OPEN, CLOSE)	Enables control of light received at the camera lens.
FOCUS (IN, OUT)	Provides control of camera focus.
VOICE SYNTHESIZER	
VOICE ON	Activates preprogrammed voice synthesizer for standardized flight instructions.

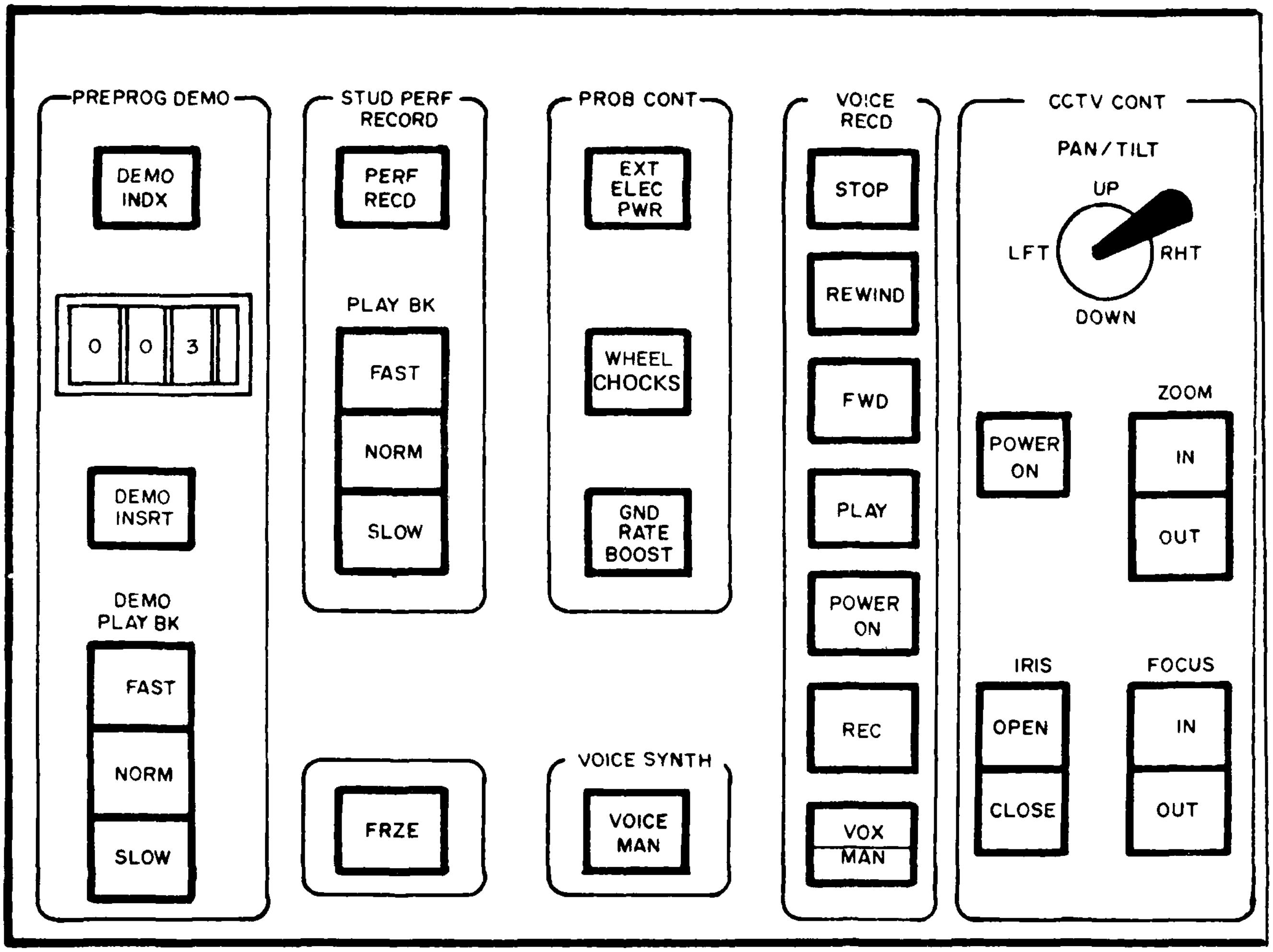


Figure B-34. IOS panel no. 21, training features and CCTV controls.

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